

WS THE *W. H. Hall.*
ANATOMY
OF THE 1750.
HUMAN BONES and NERVES.

WITH
An Account of the reciprocal
Motions of the HEART,

AND
A Description of the HUMAN LAC-
TEAL SAC and DUCT.

Corrected and enlarged in the FIFTH EDITION.

By ALEXANDER MONRO, *Professor of Ana-
tomy in the University of Edinburgh,* and
F. R. S.

E D I N B U R G H:

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MDCCL.



T O T H E
STUDENTS of ANATOMY
I N T H E
University of E D I N B U R G H.

GENTLEMEN,

WHEN *this Osteology was first printed in 1726, I did not know that Albinus, Winslow, and Palfyn, were to publish Descriptions of the Bones; otherwise my Papers probably would have remained yet undelivered to the Printers. I however flatter myself, that this Essay has been of Use to the Gentlemen who did me the Honour to attend my Lectures, by assisting them to understand my Sense and Representation of Things in this fundamental Part of Anatomy; and that it has possibly been of more Advantage to them than a more compleat Work from an abler Hand, unless my Demonstrations had been in the Order and Method of such an Author.*

This View of your Improvement, Gentlemen, is a prevailing Argument with me, to cause this Essay to be reprinted; and you cannot reasonably blame me, if I likewise acknowledge another Motive for it, which more particularly relates to myself. In a new Edition an Author has an Opportunity of making his Works more correct, compleat, and consequently acceptable to the Publick, who may perhaps be indulgent enough to think this little Treatise not altogether useless; since more Reasoning on the Structure and morbid Phænomena of Bones is to be found in it, than in the other Writers, who have confined themselves almost entirely to the descriptive or proper anatomical Part of the Osteology.

I have here kept to the Plan of the former Editions, by first considering, in the Order that seemed to me most natural and methodical, every thing which I thought necessary to be known concerning Bones in general; and, in the second Part, I have described the several Bones composing the Skeleton.

The Bones of Adults are what I principally endeavour to describe; but I have
added

added as much of the Osteogenea, as I think serviceable in the Practice of Physick and Surgery.

That little might be omitted of what was formerly done on this Subject, I have taken all the Assistance I could from Books; but have never asserted any anatomical Fact on their Authority, without consulting the Life, from which all the Descriptions are made; and therefore the Quotations from such Books, serve only to do Justice to the Authors, who have remarked any thing in the Structure of the Parts that was commonly omitted, and to initiate you in the History of Anatomy; which I once proposed to make complete, so far as related to this Subject; but not being able to procure several Books, and being sensible how many more may have never come to my Knowledge, I laid aside this Design, of Purpose omitted many I could have inserted, and in some Places I have changed an older Author for a later one, who has more fully or clearly described what I treated of. Beside Anatomists, I have also named several other Authors to confirm my Reasoning by practical Cases; of which it is not to be supposed

posed my Experience could furnish a sufficient Variety.

You'll readily observe, that I quote no Passages with a View to criticise or condemn them. This Precaution of giving no Offence, is very necessary in those who are sufficiently conscious of their being liable to lay themselves open to just Censure; and it prevents Occasions of useless Wrangling, in which generally both Parties are Losers, and the Publick has little Advantage.

In this Treatise I always make use of the most common Name of each Part, and have put the synonymous Names to be met with in Books at the Foot of the Page, that the Reading might be smoother, and you might consult them at your Leisure, to assist you in understanding different Authors.

The Descriptions and Reasoning are here blended, without which I always find young Anatomists soon are disgusted with Authors: Their Imaginations cannot follow a long Chain of Descriptions, especially when they are not taught at the same time the Uses which the described Parts serve: Their Minds must have some Relaxation, by a Mixture of Reasoning, which
never

never misses to strike the Fancy agreeably, and raises a strong Desire to understand the Principles on which it depends.

The Phænomena of Diseases are all deduced in this Essay, from the Structure of the Parts, by way of Corollaries and Questions, which such an anatomical Work confined me to. And this Method has otherwise a good Effect: For, when one meets with an useful Proposition, and is obliged to employ a little Thought to find out its Solution, the Impression it makes is deeper, and he acquires a Fondness of it, as being in part his own Discovery. My Pupils have frequently assured me, that they could, with very small Reflexion, trace out the whole Reasoning from which my Conclusions were drawn; I hope their Successors will also think this an agreeable Manner of being instructed.

Those Gentlemen who desired I would add the Lectures which I pronounce in my Colleges as a Commentary upon the Text, where the Diseases are mentioned, will, I persuade myself, excuse me for not complying with their Desire, when they consider the Design of this is to be a School-book, and how great
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the Difference is between instructing Youth in private, and pretending to inform the Publick. Art. xxiv. Vol. v. of Medical Essays and Observations, published in this Place, is one of these Lectures which I gave as a Commentary on the Paragraph (p. 13.) concerning the different kinds of Caries.

In this Edition, I have corrected the Mistakes and obscure Passages which I discovered in the former, and in some Places I have made the Descriptions more full and exact, aiming all I could to shun unnecessary Minuteness on the one hand, and a blameable Inaccuracy on the other: Whether I have hit that just Medium, is what you and the Publick must now judge.

I am still of opinion, that Figures of the Bones, would at any rate have been unnecessary in a Book that is intended to be illustrated and explained by the Originals themselves; but would be much more so now, when my ingenious Friend Mr. Cheselden, and Dr. Albinus, have published such elegant ones; and the Pictures in the Osteography published here, are disposed in the Order which I follow.

You

You have advantageous Opportunities in this Place, of studying all the Parts of Medicine, under the Professors of its different Branches in the University, and of seeing the Practice of Pharmacy, Surgery, and Physick, with our Surgeon-apothecaries, and in the Infirmary, where the diseased Poor are carefully treated. These your Interest, and, I hope, your Inclinations, will lead you, Gentlemen, so to improve, as they may prove the happy Means of your making a considerable Figure in your several Stations. Whatever Assistance is in my Power towards such a desirable Event, shall be given with the greatest Pleasure, by,

Your humble Servant,

ALEX^R MONRO.

THE

1841

The following is a list of the names of the persons who have been admitted to the office of the Secretary of the Board of Education, since the last meeting of the Board, on the 1st of January, 1841.

Admitted on the 1st of January, 1841.

Admitted on the 1st of February, 1841.

Admitted on the 1st of March, 1841.

Admitted on the 1st of April, 1841.

Admitted on the 1st of May, 1841.

Admitted on the 1st of June, 1841.

Admitted on the 1st of July, 1841.

Admitted on the 1st of August, 1841.

Admitted on the 1st of September, 1841.

Admitted on the 1st of October, 1841.

Admitted on the 1st of November, 1841.

Admitted on the 1st of December, 1841.

For further particulars, see the Report of the Secretary.

WILLIAM M. B. B.

THE

THE
ANATOMY
OF THE
HUMAN BONES.

PART I.

Of the Bones in general.

BONES are covered by a Membrane, named on that account PERIOSTEUM*, which is so necessary to them, that we must examine its Texture and Uses, before we can understand their Structure.

The *Periosteum*, as well as most other Membranes, can be divided into *Layers* of Fibres. The *exterior* ones, composed of the Fibres of the Muscles connected to the Bones, vary in their Number, Size and Direction, and consequently occasion a very great Difference in the Thickness and Strength of the *Periosteum* of different Bones, and even of the different Parts of

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* *Membrana circumossalis, ormentum ossibus impositum.*

the same Bone.—The *internal* Layer is every where nearly of a similar Structure, and has its Fibres in the same Direction with those of the Bone to which they are contiguous. Ought not then the name *Periosteum* to be applied, strictly speaking, only to this internal Layer, to which the others are joined in an uncertain Manner and Number?

Some authors (a) endeavour to prove the internal Layer of Fibres of the *Periosteum* to be derived from the *Dura Mater*: For, say they, since the Membrane covering the Scull is plainly a Production or Continuation of the *Dura Mater*, which passes out between the Sutures; and since there are Muscles on the Head, as well as in other Parts, which might furnish a *Periosteum*, it is needless to assign different Origins to Membranes which have the same Texture and Uses. They add further, in proof of this Doctrine, that the *Periosteum* extends itself along the Ligaments of the Articulations from one Bone to another; and therefore is continued from its Origin over all the Bones of the Body.—While Anatomists were fond of the Hypothesis of all Membranes being derived from one or other of the two that cover the Brain, a Dispute of this kind might be thought of Consequence: But now that the Hypothesis is neglected as useless, it is needless to examine the Arguments for or against it.

Except where Muscles are inserted into the *Periosteum*, its external Surface is connected

(a) Havers, Osteolog. nov. Disc. i. p. 16.

ned to the surrounding Parts by thin cellular Membranes, which can easily be stretched considerably, but shorten themselves whenever the stretching Force is removed. When these Membranes are cut or broken, they collapse into such a small Space, that the Surface of the *Periosteum* seems smooth and equal.

When we attempt to tear off the *Periosteum* from Bones, we see a great Number of white Threads produced from the Membrane into them; and, after a successful Injection of the Arteries with a red Liquor, numerous Vessels are not only seen on the *Periosteum* (a), but most of the Fibres sent from the Membrane to the Bone, shew themselves to be Vessels entering it, with the injected Liquor in them; and when they are broken, by tearing off the *Periosteum*, the Surface of the Bone is almost covered with red Points.

The Veins corresponding to these Arteries are sometimes to be seen in Subjects that die with their Vessels full of Blood; though such numerous Ramifications of them cannot be demonstrated as of the Arteries, because few of them have naturally coloured Liquors in them, and such Liquors cannot be injected artfully into them.

The great Sensibility of the *Periosteum* in the deep-seated Species of *Paronychia*, in *Exostoses*, *Nodi*, *Tophi*, and *Gummata*, from a *Lues venerea*, is a sufficient Proof that it is

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well

(a) *Ruysh. Epist. 5. Tab. 5. Fig. 1. 2. Epist. 8. Tab. 9. Fig. 1. 9.*

well provided with Nerves, though they are too small to be traced upon it; and therefore one cannot well determine, whether they are sent along with the Arteries in the common Way, or are derived from the tendinous Fibres of the Muscles expanded on the *Periosteum*.

Vessels also pass through the *Periosteum* to the Marrow; of which more hereafter. And frequently Muscles pierce through the *Periosteum*, to be inserted into the Bones.

The chief Uses of the *Periosteum* are .

1. To allow the Muscles, when they contract or are stretched, to move and slide easily upon the Bones; the smooth Surface of this Membrane preventing any ill Effects of their Friction upon each other.
2. To keep in due Order; and to support the Vessels in their Passage to the Bones.
3. By being firmly braced on the Bones, to assist in setting Limits to their Increase, and to check their Overgrowth.
4. To strengthen the Junction of the Bones with their *Epiphyses*, Ligaments and Cartilages, which are easily separated in young Creatures, when this Membrane is taken away.
5. To afford convenient Origin and Insertion to several Muscles which are fixed to this Membrane.

And, lastly, to warn us when any Injury is offered to the Parts it covers; which, being insensible, might otherwise be destroyed without our Knowledge, or endeavouring to procure a Remedy.

When the cellular Substance connecting the *Periosteum* to the surrounding Parts is destroyed,

destroyed, these Parts are fixed to that Membrane, and lose the sliding Motion they had upon it; as we see daily in Issues, or any other tedious Suppurations near a Bone.—When the Vessels which go from the *Periosteum* to the Bones, are broken or eroded, a Collection of Liquor is made between them, which produces a sordid Ulcer or rotten Bone. This often is the Case after Fractures of Bones, and Inflammations of the *Periosteum*, or after *Small-pox*, *Measles*, *Spotted Fevers*, and *Erysipelas*.—Do not the Disorders of the *Periosteum*, coming along with or soon after the cutaneous Diseases, indicate a Similarity of Structure in the *Periosteum* and Skin?

The BONES are the most hard and solid Part of the Body, and, as all other Parts where large Vessels do not enter, are generally of a white Colour; only in a living Creature they are bluish, which is owing to the Blood in the small Vessels under their Surface. The less therefore and fewer the Vessels are, and the thicker and firmer the bony Surface covering the Vessels is, the Bones are whiter. Hence the Bones of Adults are whiter than those of Children; and, in both young and old, the white Colour of different Bones, or of the several Parts of the same Bone, is always in Proportion to their Vessels and Solidities; which Circumstances ought to be regarded by Surgeons, when they are to judge of the Condition of Bones laid bare.

Bones are composed of a great many *Plates* *, each of which is made up of Fibres or *Strings* united by smaller *Fibrils* (a) ; which being irregularly disposed, and interwoven with the other larger Fibres, make a reticular Work.—This Texture is plainly seen in the Bones of Fœtuses, which have not their Parts closely compacted, and in the Bones of Adults which have been burnt, long exposed to the Weather, or whose Composition has been made loose by Diseases.—The Chinks which are generally made according to the Direction of the larger Fibres of Bones that have undergone the Action of Fire, or of the Weather, shew the greater Strength of these than of the Fibres which connect them.—Numerous accurate Observations of the different Times in which Exfoliations are made from the Sides or Ends of similar Bones, might bid fair to determine what is the proportional Force of Cohesion in the two sorts of Fibres.

The Plates are said (b) to be firmly joined to each other by a great Number of *Claviculi*, or small bony Processes, which, rising from the inner Plates, pierce through some, and are fixed into the more external ones. Of these Nails, four kinds, viz. the *perpendicular*, *oblique*, *beaded*, and *crooked*, have been described : But in Bones fitly prepared,

* Squamæ, Bractææ, Laminæ.

(a) *Malpigh. Anat. Plant. & oper. posthum.*

(b) *Gagliard. Anat. ossium nov. invent. illustrat. cap. 1. Obs. 1.*

pared, I could only see numerous irregular Processes rising out from the Plates (a).

Though the exterior Part of Bones is composed of firm compact Plates, yet they are all more or less cavernous internally. In some (e. g. middle thin Part of the *Scapula* and *Os Ilium*) the solid Sides are brought so near, that little Cavity can be seen; and in others (middle of *Os Humeri*, *Femoris*, &c.) the Cavities are so large, that such Bones are generally esteemed to be hollow or fistular. But the internal spongy Texture is evident in young Animals; and some of it may be seen to remain in those of greatest Age, when Bones are cautiously opened, after they have been kept so long as to be free of the Oil they contain, or after being burnt.

This spongy cavernous internal Part of Bones, is generally called their *Cancelli*, or LATTICE-WORK, and is formed in the following Manner. The Plates are firmly joined about the middle of the Bone; but as they are extended towards its Ends, the more internal Plates separate from the exterior, and stretch out their Fibres towards the Axis of the Bone, where they are interwoven with the Fibres of other Plates that have been sent off in the same Way. Seeing the Plates are thus constantly going off, the solid Sides of the Bones must become thinner, and the Lattice-work must be thicker and stronger, towards their Ends. This is evident in many of them, where

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(a) *Malpighi. oper. posthum.*

the solid Sides of their Middle is very thick, and the *Cancelli* are scarce observable; whereas, at the Ends, where their Diameter is greatest, the solid Walls or Sides are not thicker than Paper, and the *Cancelli* are numerous and large enough to fill up the whole Space left between the Sides.

The Twisting and Windings which these *Cancelli* make, and the Interstices which they leave, differ considerably in Figure, Number and Size, and therefore form little Cells, which are as different, but communicate with each other. Some Writers (a) minutely remark these different Appearances of the *Cancelli*, after they begin to separate from the Plates, and from thence distinguish them into *wrinkled, perforated, and Net-like*.

The *Cancelli* sustain the membranous Bags of the Marrow which are stretched upon them, and thereby hinder these membranous Parts to be torn or removed out of their proper Places, in the violent Motions and different Postures which the Bones are employed in, or in the several Degrees of Distention which the Bags are brought to, by the Increase or Decrease of the Quantity of Marrow. This Support which the *Cancelli* afford the Marrow, also saves its Membranes and Vessels, in the lower Parts of the Bones, from being compressed by the Weight of the Marrow above.

The Depressions between the Fibres of the external Plates of Bones appear like so many

(a) *Gagliard. Anat. ossium, cap. 1. Obs. 4. 3. 6. 7.*

ny Furrows on their Surface, into each of which the *Periosteum* enters; by which the Surface of Contact, consequently the Cohesion, between it and the Bone, is considerably increased, and a greater Number of Vessels is sent from it into the Bone, than if it was a plain Surface.

Both on the Ridges and Furrows, numerous little Pits or Orifices of Canals are to be seen, by which the Vessels pass to and from the Bones.

After a successful Injection, the Arteries can be traced in their Course, from the Pits to the Plates and Fibres; and, in sawing, cutting or rasping the Bones of living Creatures, these Vessels discover themselves, by the small Drops of Blood which then ouze out from the most solid Part of the Bones. But the clearest Demonstration of the intimate Distribution of these small Arteries, is, to observe the Effect of such a tinging Substance as can retain its Colour, when swallowed, digested and mixed with the Blood of any living Animal, and at the same time has Particles small enough to be conveyed into the Vessels of the Bones; such is *Rubia tinctorum*, Madder-root (*a*): For we see the gradual Advances which this Tincture makes from the *Periosteum* into the more internal Parts of the Bones, and how universally the Distribution of the Liquors is made, the whole bony Substance being tinged.

(*a*) Philosoph. Transact. Num. 442. Art. 8. Num. 443. Art. 2. Num. 457. Art. 4. Mem. de l'Acad. des Sciences. 1739. 1742.

tinged. Whether the Time in which this tinging Liquour passes from the outer to the internal Plates, till all the Plates are made of its Colour, and the Time which the disappearing of the Dye, after giving the Creature no more of this sort of Food, makes us think it takes to return, are the same in which the natural Liquors circulate, is uncertain; because this tinging Substance may move more slowly, or may pass more quickly, than the natural Liquors do. —The Arteries are larger near each End than at the Middle of the large Bones that are much moved; because they not only serve the bony Plates near the Ends, but pass through them to the Marrow. —As Animals advance in Age, the Arteries of the Bones become less capacious; as is evident, 1. From the Bones of Adults having less Blood in them than those of Children have. 2. From their becoming incapable in old Age of admitting the coloured Powders used in Injections, which easily pass in Youth. And, 3. From the Bones of old Creatures being more difficultly tinged with Madder than those of young ones. —If Authors have not mistaken, the Arteries of Bones have sometimes become very large (a).

Since the Veins of the *Periosteum* cannot be filled with a coloured Injection, we are not to expect that their Branches, the Veins of the Bones, can be shewn; for they are too

(a) *Diemerbroeck*: Anat. lib. 9. cap. 1. --- *Mery*. Hist. de l'Acad. des Sciences, 1704.

too small to be seen without such Assistance: But we may conclude from Arteries being accompanied with Veins so far as we can trace them in every other Part of the Body, that there are also Veins in the Bones; and the disappearing of the Tincture of *Madder*, after Bones of living Animals are coloured with it, could not be without such Veins to carry it away.

The Bones of a living Animal are so insensible, that they can be cut, rasped, or burnt, without putting the Creature to Pain, and their Nerves cannot be shewn by Dissection; from which it might be inferred that they have no Nerves distributed to them: But the general Tenor of Nature, which bestows Nerves to all the other Parts, should prevent our drawing such a Conclusion. And if Sensibility is a sure Proof of Nerves entering into the Composition of any Part, as it is generally allowed to be, we have sufficient Evidence of Nerves here in the Bones; for the granulated red Flesh which sprouts out from them, after an Amputation of a Limb, or performing the Operation of the *Trepan*, or after an *Exfoliation*, is exquisitely sensible: And, in some Ulcers of Bones, where the *Periosteum* was all separated, the Patient suffered racking Pain, if the Bone was touched with a rough Instrument; nor was he free of Pain after the Bone was perforated (*a*).—The Reason why the Nerves of rigid hard Bones become
insensible,

(*a*) Nicol Massa lib. introd. Anat. cap. 30.

insensible, is, That all Nerves must have a considerable Degree of Flexibility at the Part where Objects are applied, otherwise it cannot be affected by their Impressions. We see this illustrated in a very common analogous Case, the Growth of a new Nail : When the former one has suppurated off, the thin Membrane which first appears, is exquisitely sensible ; but gradually becomes dull in its Sensation, till it can be cut or scraped, without causing Pain, after it is formed into a hard Nail.

From what has been said of the Vessels of Bones, it is evident, that there is a constant Circulation of Fluids in every Part of them ; and that there is a perpetual Waste and Renewal of the Particles which compose the solid Fibres of Bones, as well as of other Parts of the Body ; the Addition from the Fluids exceeding the Waste during the Growth of the Bones ; the Renewal and Waste keeping pretty near *par* in adult middle Age ; and the Waste exceeding the Supply from the Liquors in old Age ; as is demonstrable from their Weight : For each Bone increases in Weight, as a Person approaches to Maturity ; continues of nearly the same Weight till old Age begins, and then becomes lighter.—The specific Gravity of the solid Sides, on the contrary, increases by Age ; for then they become more hard, compact and dense. In consequence of this, the Bones of old People are thinner and firmer in their Sides, and have larger Cavities than those of young Persons.

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The vascular Texture of Bones must make them subject to *Obstructions*, *Ecchymoses*, *Ulcers*, *Gangrenes*, and most other Diseases which the softer Parts are affected with; and therefore there may be a greater Variety of *Caries* than is commonly described (a.)

Hence we can account for the following Appearances.

Hæmorrhagies from fungous Flesh rising out from the most solid Part of a cut Bone (b).

The regular alternate Elevation and subsiding or apparent Pulsation so frequently to be seen in some of the Cells of a carious Bone.

Cells resembling *Cancelli*, sometimes seen in the Part of a Bone, which, in a natural State, is the most solid and firm (c).

A Bone as a Tube including another Bone within it (d).

On the internal Surface of the solid Parts of Bones, there are Orifices of Canals, which pass outwards through the Plates to open into other Canals that are in a longitudinal Direction, from which other *transverse* Passages go out to terminate in other *longitudinal* Canals; and this Structure is continued through the whole Substance of Bones, both these kinds of Canals becoming smaller gradually as they approach the outer Surface.—These Canals are to be seen to

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(a) Edinburgh Medical Essays and Obs. Vol. V. Art. 25.

(b) Medical Essays, Vol. IV. Art. 21.

(c) *Russch. Thes.* 8. Num. 8. *Thes.* 10. Num. 176.

(d) *Idem*, *ibid.*

the best Advantage in a Bone burnt till it is white: When it is broken transversely, the Orifices of the *longitudinal* Canals are in View; and when we separate the Plates, the *transverse* ones are to be observed. Here however we are in danger of believing both these sorts of Canals more numerous than they really are; because the Holes made by the Processes connecting the Plates of Bones have the Appearance of the *transverse* (a), and the Passages for the Blood-vessels resemble the *longitudinal* Canals. I don't know how we are to keep free of Error about the *transverse* Canals; but think we may distinguish between the two kinds of *longitudinal* ones; for the Passages of the Vessels are largest near the external Surface of the Bone, and every transverse Section of them is circular; whereas the *longitudinal Canals* are largest near the *Cancelli*, and their transverse Sections appear to me of a flat oval Figure, which may be owing to the different *Momentum* of the Fluids conveyed in them.—The Situation of the larger longitudinal Canals, and of the Passages of the larger Vessels, makes a Bone appear more dense and compact in the middle of its solid Sides, than towards its outer and inner Surfaces, where it is spongy.

We see Marrow contained in the larger transverse and longitudinal Canals just now described, and from thence judge that it passes also into the smaller ones. The Drops of Oil which we discover with a Microscope
every

(a) Morgagn. Advers. 2. Animad. 25.

every where on the Surface of a recent Bone fractured transversely, and the ouſing of Oil through the moſt ſolid Bones of a Skeleton, which renders them greaſy and yellow, are a Confirmation of the Uſe of theſe Canals. Of what Advantage this Diſtribution of the Marrow through the Subſtance of Bones is, will be mentioned when the Nature and Uſe of this animal Oil is inquired into.

Moſt Bones have one or more large oblique Canals formed through their Sides for the Paſſage of the medullary Veſſels, which are to be deſcribed afterwards.

Bones expoſed to a ſtrong Fire in Chemical Veſſels, are reſolved, in the ſame Manner as the other Parts of Animals, into *Phlegm*, *Spirit*, *volatile Salt*, *fetid Oil*, and a black *Caput mortuum*. But the Proportion of theſe Principles varies according to the Age, Solidities, and other Circumſtances of Bones. Young Bones yield the largeſt Proportion of *Phlegm*; ſpongy Bones afford moſt *Oil*, and ſolid ones give moſt Salt and black *Reſiduum*.—Though this *Reſiduum* can ſcarce be changed by the Force of Fire while it is in cloſe Veſſels; yet, when it is burnt in an open Fire, the tenacious Oil, to which it owes its black Colour, is forced away, and a white Earth is left that has little or no fixed Salt in it; on which account theſe Aſhes are the moſt proper Materials for forming into Veſſels that are to undergo the greateſt Force of Fire, being ſcarce capable of vitrifying by Fire, as moſt other

earthy Substances do. This Earth seems to be the proper constituent solid Part of Bones, and the other Principles give it Firmness and Tenacity: For the Quantity of the Earth is so great, that, after all the other Principles are separated from a Bone, its former Shape and Size remain (*a*); but it is very brittle till it is moistened with Water or Oil, when it recovers some Tenacity.—The Increase of the Proportion of Earth in old Peoples Bones, is one Reason of their being more brittle than those of young People are.

The Bones sustain and defend the other Parts of the Body.

Bones are lined within, as well as covered externally with a Membrane; which is therefore commonly called PERIOSTEUM INTERNUM.

The *internal Periosteum* is an extremely fine Membrane; nay frequently it has a loose reticular Texture; and therefore it is compared by some to the *Arachnoid Coat* of the spinal Marrow: So that we cannot expect to divide it into Layers, as we can divide the *external Periosteum*. We can however observe its Processes entering into the transverse Pores of the Bones, where probably they are continued to form the immediate Canals for the Marrow distributed thro' the Substance of the Bones; and along with them Vessels may be sent, as from the *external Periosteum*, into the Bone (*b*); but they

(*a*) *Havers*, Osteolog. nov. Disc. I. p. 32.

(*b*) *Winslow*, Exposition Anat. des Os frais, § 82. 83.

they are not so large as that I could ever make an Injection enter them, nor could I see them any other Way. These Processes being of a very delicate Texture, the Adhesion of this Membrane to the Bone is so small, that it separates commonly more easily from the Bone than from the Marrow which it contains: Wherefore, one might call it the common Membrane of the Marrow, rather than by the Name it now has. But whether one or t'other Designation ought to be given it, is not worthy a Dispute.

From the internal Surface of the internal *Periosteum*, a great Number of thin Membranes are produced; which, passing a-cross the Cavity, unite with others of the same kind, and form so many distinct Bags, which communicate with each other; and these again are subdivided into communicating vesicular Cells, in which the Marrow is contained. Hence it is, that the Marrow, when hardened, and viewed with a Microscope, appears like a Cluster of small Pearl; and that the hardened Marrow of Bones buried long under Ground, or laid sometime in Water, and then dried, is granulous (a). This Texture is much the same with what obtains in the other cellular Parts of the Body, where Fat is collected; only that the Cells containing the Marrow are smaller than those of the *Tunica adiposa* or *cellulosa* elsewhere, which probably is owing to

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(a) *Ruysh. Thesaur. 9. Num. 2. & Advers. Dec. 111. Obs. 9.*

their being inclosed in the Bones, where they are not so much stretched or extended as in other Parts.

The MARROW is the oily Part of the Blood, separated by small Arteries, and deposited into these Cells. Its Colour and Consistence may therefore vary according to the State of the Vessels, and their Distribution on the Membranes of the Cells.

Besides the Arteries, which I mentioned already, *p.* 10. to be sent from the Bones to the Marrow, there is at least one Artery for each Bone; several Bones have more, whose principal Use is to convey and seern this oily Matter. After these Arteries have pierced the solid Side of a Bone, they are divided into several Branches; which soon are distributed every where on the internal *Periosteum*, and afterwards spread their Branches on the medullary Cells.

The Blood, which remains after the Secretion of the Marrow, is returned by proper Veins, which are collected from the Membranes into one or two large Trunks, to pass out at the same Holes or Passages at which the Artery or Arteries enter.

The general Rule of the small Vessels decreasing in their Capacities as Animals advance in Age, to which many Phænomena in the Animal Oeconomy are owing, obtains here: For though the Trunks of the medullary Vessels enlarge as Animals turn older; yet the small Branches become smaller; as is evident from Injections, which cannot be made to pass near so far in these Vessels of Adults

Adults as of Children. Hence the Marrow is bloody in Children, oily and balmy in middle Age, and thin and watery in old People.

We can trace the Nerves a considerable Way in their Division on the Membrane of the Marrow along with the Blood-vessels; but their minute Ramifications proper to the particular Cells, are too small to dissect. By Experiments, however, made on the Marrow, when Bones of living Animals are opened or cut through (a), and from the racking Pain with which Suppurations within Bones are frequently attended, we have sufficient Proof, that the Membranes here are very sensible, and consequently have Nerves distributed to them. *Hippocrates* (b) might therefore say justly, that a Wound penetrating into the Cavity of a Bone may produce a *Delirium*.

The Arteries, Veins and Nerves of the Marrow, wrapt up in one common Coat, from the *Periosteum*, pass through the Bones by proper Canals; the most considerable of which are about the Middle of each Bone, and are very oblique. Sometimes these Vessels continue at a little Distance in their Passage, when the Canal is divided by a small bony Partition or two.

The Marrow is of very considerable Use to the Bones; for, by entering their transverse Canals, and passing from them into the longitudinal ones, it is communicated to
all

(a) *Du Verney*, Memoirs de l'Acad. des Sciences, 1700.

(b) Aphorism. § 7. Aph. 24.

all the Plates, to soften and connect their Fibres, whereby they are preserved from becoming too brittle; as we see they do in burnt Bones, or those long exposed to the Air; in People labouring under old Age, Pox or Scurvy: In all which Cases, the Oil is either in too little Quantity, or has its natural good Qualities changed for worse ones.

Besides this Advantage which the Substance of Bones has from the Marrow, their Articulations are said (a) to receive no less Benefit from it: For it is thought that the Marrow passes into the articular Cavities, through the Holes which are in the Bones near the large Joints. And, as a Proof of this, it is observed, that Butchers, upon seeing the greater or lesser Quantity of Marrow in the Bones of Cows, can tell whether they have travelled far or little before they were slaughtered.

When the Marrow, after having served the Uses mentioned, is reassumed into the Mass of the Blood, (as it is continually, in common with all the other secreted Liquors that have not Passages formed for conveying them out of the Body), it corrects the too great Acrimony communicated to the saline Particles of our Fluids, by their Circulation and Heat; in the same manner as the lixivial Salts are blunted by Oil in making Soap. Hence, in acute Diseases,

(a) Joan. de Muralto Vade mecum, Anat. Exercit. V. § 3.
Havers, Osteolog. nov. Disc. 3. p. 179:

Diseases, the Marrow, as well as the other Fat of the Body, is quickly wasted.

Since it is the Nature of all Oil to become thin and rancid when exposed long to Heat, and Bones have much Oil in their firm hard Substance, we may know why an ungrateful Smell, and black thin *Ichor*; proceed more from corrupted Bones, than from any other Part of the Body; and we can understand the Reason of the Changes of Colour which Bones undergo, according to their different Degrees of Mortification.—Hence likewise we may learn the Cause of a *Spina ventosa*, and of the Difficulty of curing such *Caries* of Bones as proceed from an Obstruction, and consequent Putrefaction of the Marrow; and of the quick Pulse, Thirst, and *hectic Paroxysms*, so often attending these Diseases. These *Phænomena* also teach us the Reason of the fatal *Prognosis* taken from black fetid Urine in Fevers.

Though Bones so far agree in their Structure and annexed Parts, yet we may observe a considerable Difference among them in their Magnitude, Figure, Situation, Substance, Connexion, Uses, &c. From which Authors have taken Occasion to distinguish them into as many Classes as they could enumerate of these different Circumstances. But these being obvious to every Person that looks on Bones, I shall only mention one of them; which comprehends very near the whole Bones of the Body, and at the same time leads us to examine the most considerable

considerable Variety that is to be found in the Disposition of their constituent Parts, and in their Uses. It is this, that some Bones are *broad* and *flat*, while others are *long* and *round*.

The *broad* Bones have thin Sides, by the Plates being soon and equally sent off to form the Lattice-work; which therefore is thicker, and nearly of an equal Form all through. By this Structure, they are well adapted to their Uses, of affording a large enough Surface for the Muscles to rise from, and move upon, and of defending sufficiently the Parts which they inclose.

The *round* Bones have thick strong Walls in the Middle, and become very thin towards their Ends, which is owing to very few Plates separating at their Middle; where, on that account, the *Cancelli* are so fine and small, that they are not taken notice of: But such Bones are said to have a large Reservoir of Oil in this Place. Towards their Ends the Lattice-work becomes very thick, and rather more compleat than in the other sort of Bones.—These round Bones having strong Forces naturally applied to them, and being otherwise exposed to violent Injuries, have need of a cylindrical Figure to resist external Pressure, and of a considerable Quantity of Oil to preserve them from becoming too brittle. Besides which, they are advantageously provided with thick Sides towards their Middle, where the greatest Forces are applied to injure them; while their Hollowness in-

creases

creases their Diameter, and consequently their Strength, to resist Forces applied to break them transversely (a). Thus, for instance, in estimating the proportional Resistance of two cylindrical Bones of unequal Diameters, but consisting of an equal Number of similar Fibres uniformly disposed round each, it is plain,

1. That the absolute Force of these two Bones is equal, because they consist of equal Numbers of similar Fibres.

2. That the absolute Forces of all the Fibres in each Bone have the same Effect in resisting any Power applied to break them, as if the Sum of all their Forces was united in the respective Centers of the transverse Sections where the Fractures are to be made. For, by Hypothesis, the Fibres being uniformly disposed in each, there is not any Fibre in either Bone that has not a corresponding Fibre; the Sum of both whose Distances from the Axis of Revolution (about which all the Parts of the Bone must revolve in breaking) is equal to two Semidiameters of the Bone: Consequently each Fibre, and all the Fibres, may be regarded as resisting at the Distance of one Semidiameter or *Radius* from this Axis, that is, in the Center.

3. Since the united Force of all the Fibres is to be regarded as resisting at a Distance from the Center of Motion equal to the Semidiameter, it follows, that the total Resistance of all these Fibres, or the Strength
of

(a) *Galilei: Mechanic. Dialog. 2.*

of the Bone is proportional to its Semi-diameter, and consequently to its Diameter.

I have here taken for an Example one of the most simple Cases for calculating the proportional Forces of Bones. But, was it not too foreign to the present Design, it might be universally demonstrated, that, of whatever Figure Bones are, and in whatever Manner their Fibres are disposed, their Strength must always be in a *Ratio*, compounded of the Area of their transverse Sections, or of their Quantity of bony Matter, and of the Distance of the Center of Gravity of these Sections from the Center of Motion or Fulcrum, on which the Bone is supposed to be broken (*a*).

Since therefore the Strength of Bones depends on their Number of Fibres, or Quantity of Matter, and the Largeness of their Diameters, one may conclude, that the Part of a Bone formerly fractured, and reunited by a *Callus*, must be stronger than it was before the Fracture happened; because both these Advantages are obtained by a *Callus*: Which is a wise Provision, since Bones are never set in such a good Direction as they were naturally of; and then where-ever a *Callus* is formed, there is such an Obstruction of the Vessels, that if the Bone was again broken in the same Place, the *ossifick* Matter could not so easily be conveyed to reunite it. This *Callus* may indeed,

(*a*) See the Demonstration of this Theorem by Dr. Porterfield in the *Edinburgh Medical Essays*, Vol. 1, Art. 10.

deed, for want of Compression, be allowed to form into a spongy cellular Substance (a); but even in this Case the Strength of the Bone is here increased by one or both the Causes above mentioned.

Many Bones have Protuberances, or *Processes* *, rising out from them. If a *Process* stands out in a roundish Ball, it is called *Caput*, or *Head*.—If the Head is flatted, it obtains the Appellation of *Condyle*.—A rough unequal Protuberance, is called *Tuberosity*.—When a *Process* rises narrow, and then becomes large, the narrow or small Part is called *Cervix*, or *Neck*.—Long Ridges of Bones, are called *Spines*.—Such *Processes* as terminate in a sharp Point, have the general Name of *Coronæ* †, or *Coronoid*, bestowed on them, though most of them receive particular Names from the Resemblance they have, or are imagined to have to other Substances, *e. g.* *Mastoid*, *Styloid*, *Anchoroid*, *Coracoid*, *Spinal*, &c. — Such *Processes* as form Brims of Cavities, are called *Supercilia* ‡.

Processes serve for the advantageous Origin and Insertion of Muscles, and render the Articulations firmer and more stable.

Before leaving this Subject, we must remark, that much the greater Number of

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what

(a) *Ruyfch. Thesaur.* 8. n. 49. *Mus. Anat. Thec. B. Reposit.* 2. n. 2.

* Ἀπόρυσσας, ἔκφυσας, ἑξοχή, προβολή, πρόβλημα, Excessus, Explanatio, Tuberculum, Gibbus, Eminentia, Productio, Extuberantia, Projectura, Enascentia.

† Rostra, Glandes.

‡ Τρύαι, ὄφρυες, ἀμβύρες, χείλη, Labra.

what are called Processes in adult Bones, discover themselves in Children to be *Epiphyfes*, or distinct Bones, which are afterwards united to the other Parts; such are the *Styloid* Processes of the temporal Bones, Processes of the *Vertebræ*, *Trochanters* of the Thigh, &c. However, as I design to insist chiefly on the Description of the adult Skeleton, in which the Union of these Parts is so intimate, that scarce any Vestige remains of their former Separation, I shall retain the common Appellation of *Apophyse*, or Process, to all such Protuberances; but shall remark the principal ones that have no just Title to this Name, when they occur in the Description of particular Bones.

On the Surfaces of a great many of the Bones, there are Cavities or Depressions: If these are deep, with large Brims, Authors name them *Cotylæ**. — If they are superficial, they obtain the Designation of *Glenæ*, or *Glenoid*. These general *Classes* are again divided into particular *Species*: — Of which *Pits* are small roundish Channels sunk perpendicularly into the Bone. — *Furrows*, are long narrow Canals, formed in the Surface; — *Nitches*, or *Notches*, small Breaches in the Bone; — *Sinuosities*, broad, but superficial Depressions without Brims; — *Fossæ*, large deep Cavities which are not equally surrounded by high Brims; — *Sinuses*, large Cavities within the Substance of

* Κοτυλίδες, ὀξυβάροι, Acetabula, Pixides, Buccellæ.

of the Bones, with small Apertures ; — *Foramina*, or Holes, Canals that pierce quite through the Substance of the Bones. — When this last sort of Cavity is extended any long Way within a Bone, the middle Part retains the Name of *Canal*, and its Ends are called *Holes*.

The Cavities allow the Heads of Bones to play in them ; they lodge and defend other Parts ; they afford safe Passage to Vessels, Muscles, &c. To mention more would engage us too much in the History of particular Bones, which more properly belongs to the Demonstration of the *Skeleton*, where we shall have Occasion to observe these several Species of Cavities.

To far the greater Number of Bones, whose Ends are not joined to other Bones by an immoveable Articulation, there are smaller ones annexed, which afterwards become scarce distinguishable from the Substance of the Bone itself. These are called *Epiphyses*, or *Appendices* *. Some Bones have one, others have two, three or four of these *Appendices* annexed by the Means of Cartilages, which are of a considerable Thickness in Children, but by Age become thinner ; the Ossification proceeding from the End of the Bone on one Side, and from the *Epiphyses* on the other, till at last, in Adults, the Place of their Conjunction can scarce be seen on the external Surface ;

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and

* *Applantatio, Additamentum, Adnascencia, Adnexum, Perone.*

and it is only sometimes that we can then see any Mark of Distinction in the *Cancelli* (a).

Several Processes (e. g. *Trochanters* of the Thigh, *Spine* of the *Scapula*, &c.) have *Epiphyses*, and Processes frequently rise out from *Epiphyses*; for Example, at the lower End of the *Femur*, *Ulna*, *Tibia*, &c. (b).

The *Epiphyses* are united chiefly to such Bones as are destin'd for frequent and violent Motion; and for this Purpose they are wisely framed of a larger Diameter than the Bone they belong to; for by this means, the Surface of Contact between the two Bones of any Articulation being increased, their Conjunction becomes firmer, and the Muscles inserted into them act with greater Force, by reason of their Axes being further removed from the Center of Motion. These Advantages might indeed have been obtained by the Expansion of the End of the Bone itself, to a Thickness equal to that of the *Epiphyses*; but then the constant Separation of new Plates to form so wide a cellular Structure, must have left the solid Sides of the Bones so thin, as to yield easily, either to the Action of the Muscles fixed to them, and passing over them, to the Weight several of them are obliged to support, or to the Application of any other external Force.

Besides

(a) *Winslow*, Exposition Anatomique de Corps Humain Traite des Os, § 116.

(b) *Vesal*. De Human. Corp. fabrica, lib. 1. cap. 3.

Besides these Uses, the *Epiphyses* serve other Purposes; such as, securing the Ligaments of the Articulations which rise out from between the Bones and them; for, as soon as these Parts are intimately joined, the Ligaments insinuated betwixt them must have a much stronger Connexion than they could have to the smooth Surface of the Bones (a). And then the *Epiphyses* hinder the Fibres of the Bone to run out too far, and to join with its neighbouring Bone, which would deprive us of all Motion; while the Fibres of the *Epiphyses*, which seem not so much disposed in a streight Direction, are prevented from the like Inconvenience, by the Interposition of Cartilages. That we should be liable to such an Inconvenience without this Mechanism, is evident from the Observations of the bony Processes, which jutt out preternaturally from Bones, when the *Periosteum* is destroyed, and the Bones are not restrained in their Growth; and from the Lameness which happens so frequently after the Erosion of the Cartilages, when the Fibres of two Bones designed for Motion run one into another, which is the worst Species of *Anchylosis*; as every Day happens in Wounds of the Joints, and in Ulcers from the *Paidarthrocace*, *Scrophula*, and *Spina ventosa*. The same Disease likewise frequently fol-

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lows.

(a) *Columb. De re Anatomica, lib. 1. cap. 2.-----Fallap. Expos. de Ossibus, cap. 11.*

lows the Ossification of these Gristles, from old Age, or any other Cause (a).

However solid and compact adult Bones are, yet they were once Cartilages, Membranes, nay, a mere Gelly. This needs no further Proof, than repeated Observations of *Embryos* when dissected: And how much more tender must the Bones be before that Time, when neither Knife nor Eye is capable to discover the least Rudiments of them? By degrees they become more solid, then assume the Nature of Gristles, and at last ossify; the Cohesion of their Plates and Fibres always increasing in proportion to their increased Solidities; as is evident from the Time necessary to unravel the Texture of Bones of People of different Ages, or of dense and of spongy Bones, or of the different Parts of the same Bone, and from the more tedious Exfoliations of the Bones of Adults than of Children.—As the Solidity of Bones increases, their *Periosteum* more easily separates from them. When Bones are membranous, the *Periosteum* and they cannot be distinguished; they appear to be the same Substance. When they are Cartilages, their Membrane adheres so firmly to them, that it is difficult to separate them. Where the rigid bony Fibres are, the *Periosteum* is easily taken off.—Is the Similarity of Structure and consequent greater Attraction

(a) See Examples of universal Anchylosis in *Columb. de re Anat. lib. 15.*—*Deslandes, Hist. De l'Acad. des Sciences, 1716.*—*Philos. Transact. Num. 461. § 16.*

Attraction of the Membrane and Substance it incloses, while they are both flexible, the Cause of their greater Adhesion then? or is it owing to the Vessels, that go from the one to the other, being then larger? or do both these Causes combine to produce this Effect? Or is the Membrane or Cartilage, which becomes Bone afterwards, to be considered as the same Substance with the *Periosteum*? and must these Plates of Bones be therefore all said to be Layers of the *Periosteum* hardened (a)?

The Induration of Bones is chiefly owing to their being exposed, more than any other Parts, to the strong Pressure of the great Weights they support, to the violent Contraction of the Muscles fixed to them, and to the Force of the Parts they contain, which endeavour to make Way for their own further Growth. By all this pressing Force, the solid Fibres and Vessels of Bones are thrust closer; and such Particles of the Fluids conveyed in these Vessels as are fit to be united to the Fibres, are sooner and more firmly incorporated with them, while the remaining Fluids are forcibly driven out by the Veins, to be mixed with the Mass of Blood. In consequence of this, the Vessels gradually diminish as the Bones harden. From which again we can understand one Reason, why the Bones of young Animals sooner reunite after a Fracture, than those of old, and

(a) Memoires de l'Acad. des Sciences, 1743.

and why Cattle that are put too soon to hard Labour, seldom are of such large Size as others of the same Brood who are longer kept from Labour.

That the ossifying of Bones greatly depends on Pressure, seems to be evinced from the frequent Examples we meet with of other Parts turning bony, when long exposed to the compressing Force of the surrounding Parts, or when they are subjected to the like Circumstances by their own frequent and violent Contraction. Witness, the Bones found frequently near the Base of the Heart in some old Men (*a*), and in several other Creatures. Nay, the muscular Substance of the Heart has been ossified in such (*b*), and the Arteries of old Men often become bony.—The Cartilages of the *Larynx* are generally ossified in Adults.—In Beasts of Burden, the Cartilages between the *Vertebræ* of the Back very often change into compleat Bones; and, being intimately united with the *Vertebræ*, the whole appears one continued Bone.—Nor is the *Periosteum* exempted from such an Induration (*c*).

To confirm this Argument still further, we may observe, That Bones begin their Ossification at the Places where they are most

(*a*) *Riolan. Comment. de Ossib. cap. 32.-----Bartholin. Hist. medic. Cent. 1. Hist. 50.-----Ibid. Cent 2. Hist. 45.*

(*b*) *Cheselden, Anatomy, Book 1. Introd.-----Garengect, Hist. de l'Acad. des Sciences, 1726.*

(*c*) *Peyer. Ephemerid. German. Decur. 2. Ann 7. Observ. 265.*

most exposed to these Causes, viz. in the cylindrical Bones from a middle Ring, and in the broad ones, at or near their Center, from one or more distinct Points. The Reason of which is, That these Parts are contiguous to the Bellies of the Muscles annexed to the Bones, where the swelling of these moving Powers is greatest. What the Effects of this may be, let any judge, who view some of the Bones, as the *Scapula*, and *Ossa Ilium*, which are covered with Muscles on each Side; how compact and thin they are in Adults, where the Bellies of the Muscles were lodged; whereas in Children they are thicker. But this being the middle Part of these Bones, where the greatest Number of Fibres is, this particular Place would have been much thicker in Adults, had not this forcible Cause been applied, which has not had such Effects in Children, whose Muscles have not been much exercised. — Besides, if we allow that all the Parts of a Bone are equally increased by the constant Supply of new Particles, each Fibre, and every Particle of a Fibre, endeavours to make way for its own Growth, by pushing the one next to it; and consequently by far the greatest Pressure is on the Middle, to make the Particles firm, and therefore to begin their Ossification there. Lastly, the Pulsation of the medullary Arteries, which enter the Bones near to this middle Part, may, as Authors have alledged, contribute perhaps somewhat to this Induration.

From

From the Effects of Pressure only it is, that we can account for the Bones of old People having their Sides so much thinner, yet more dense and solid, while the Cavities are so much larger, than in those of young People; and for the Prints of Muscles, Vessels, &c. being so much more strongly marked on the Surfaces of the former than of the latter, if they belong to People of near the same Condition in Life.—Pressure must likewise be the Cause, which, in People of equal Ages, makes these Prints stronger in the Bones of those who had much Labour and Exercise, than they are in People who have led an indolent unactive Life.

It is also probable, that Ossification depends on the Vessels of Bones being so disposed, and of such Diameters, as to separate a Liquor, which may easily turn into a bony Substance when it is deprived of its thinner Parts; as seems plain from the Observation of the callous Matter, separated after Fractures and Ulcers, where Part of the Bone is taken out: For in these Cases, the Vessels extending themselves, and the Liquors added to them, are gradually formed into granulated Flesh; which fill up all the Space where the Bone is taken from; then hardens, till it becomes as firm as any other Part of the Bone. This happens frequently, even when the Ends of the diseased Bone are at a considerable Distance from each other (a).

Perhaps

(a) *Hildan. de Vuln. graviss.*---Med. Essays. Vol. I. Art. 23.

Perhaps both the Causes of Ossification above mentioned, may be assisted by the Nature of the Climate People live in, and the Food they use. Whence, in hot Countries, the Inhabitants sooner come to their Height of Stature, than in the Northerly cold Regions: And thence seems to have arisen the common Practice among the Ladies, of making Puppies drink Brandy or Spirit of Wine, and of bathing them in these Liquors, to prevent their growing big. Nay, it has been observed, that much Use of such Spirits has occasioned Parts, naturally soft, to petrify in some, and to ossify in other People of no great Age (a).

From the foregoing Account of the Structure of Bones, and of their Ossification, we may understand the Reasons of the following Phænomena.

How Bones may be softened or dissolved.

How the natural Colour of Bones may be changed by some Sorts of Food (b).

Why the Bones of some People are so long of hardening, and in others never compleatly indurate.

Why, in such whose Ossification is slow, the Bones are generally thicker in proportion

(a) *Littre*, Histoire de l'Acad. des Sciences, 1706.---*Geoffroy*, Memoires de l'Acad. des Sciences, 1706.

(b) *Philosoph. Transact.* 442. Art. 8. Num. 443. Art. 2. Num. 457. Art. 4. Mem. de l'Acad. des Sciences, 1739. 1742.

tion to their Lengths, especially at their Ends; as in the *Rickets*.

How hard firm Bones have become soft and pliable by Diseases (a).

How Bones exfoliate by the rising of granulated flesh from their Surface.

How Bones may waste and diminish (b).

How Bones may become solid all through, without any Appearance of *Cancelli* (c).

Why *Epiphyses* separate from Bones in some Diseases (d).

How *Nodes*, *Tophi*, and *Exostoses*, happen after the Erosion of the external Plates of Bones in the *Lues Venerea*, *Scurvy*, *Rheumatism*, and *Gout*.

How and from what *Callus* is formed after a Fracture (e).

Why *Callus* appears to be rather the continued Substance of the *Periosteum* than of the Bone, while it continues soft and flexible; but seems continued with the Bone after it ossifies (f).

What occasions sometimes such Difficulty in curing fractured Bones; or why they never reunite, though they are reduced, and all

(a) Histoire de l'Acad. des Sciences, 1700. Mem. 1722. Gagliardi, Anatom. ossium, cap. 2. observ. 3. Ephem. Germ. Decur. 1. ann. 1. obs. 37. & Schol. Decur. 2. ann. 7. obs. 212. 235. Decur. 3. ann. 2. obs. 3.

(b) Cheselden, Anat. Book 1. Introd.---Hist. del'Acad. des Sciences, 1700.

(c) Ruysch, Thesaur. 2. Arc. 5. Thes. 3. Loc. 1. Num. 5. Thes. 9. Num. 2. not. 3.

(d) Memoires de l'Acad. des Sciences 1699.---Diemerbroeck, Anat. lib. 9. cap. 19.

(e) Memoires de l'Acad. des Sciences, 1741.

(f) Ibid.

all proper Means towards a Cure are used (a).

Why *Calluses*, after Fractures, are sometimes very thick and protuberant.

What Difference there ought to be in the Application of Bandages to Fractures of the Bones of old and of young Patients.

How Bones, remaining long unreduced after a Luxation, may have their Form so changed, as to make their Reduction very difficult, if not impossible.

Whoever is desirous to know, in what Time and Order each Bone, and its several Parts, begin to assume a bony Nature, let him consult *Kerckringius* (b,) who gives us the Delineations of Abortions from three Days after Conception, and traces the Ossification of the Bones from three Weeks, and a Month, till the Time of the Birth: To whom should be added *Coiterus* (c) and *Eyssonius* (d). An Account of this Subject might also be collected out of *Ruyseh's* Works, where some of the Mistakes committed by the former Authors are corrected: And several more Particulars to make the History of the *Osteogenea* more accurate, have since been added by *Nesbitt* (e) and *Albinus* (f).

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(a) *Meck'ren. Observ. Medico-Chirurg. Obs. 71.-----Ruyseh. Advers. Dec. 2. §. 2. Observ. Anat. Chir. obs. 4.*

(b) *Anthropograph. Ichnograph. & Osteogenea Foetuum.*

(c) *De ossibus foetus abortivi.*

(d) *De ossibus Infant. cognoscend. & curand.*

(e) *Human Osteogeny explained.*

(f) *Icones ossium foetus humani accedit osteogeniae brevis historia.*

I must refer to the Authors now quoted for the more curious Part of the human Osteogeny; not having Preparations enough to give such a full History of it as is done by them. But I shall endeavour to explain the more useful and necessary Part of the Osteogeny, by subjoining to the Description of each Bone of an Adult, its Condition in ripe Children; that is, in such as are born at the ordinary Time; and shall point out what Parts of each are afterwards joined in Form of *Epiphyses*. This, with the following general Rules, seem to me sufficient for understanding what of this Subject is necessary in the Practice of Physick and Surgery.

1. Where-ever I mention any Parts being cartilaginous, or their being still separable from the other Parts of the Bone to which they belong, I would be understood to hint, that, about seven or eight Years of Age, such Parts are ossified and united to their proper Bones, unless when it is said, that they are afterwards formed into *Epiphyses*.

2. Such as become *Epiphyses*, are generally ossified at seven or eight Years of Age; but, being for the most part moistened by *Synovia*, their external Surface is still somewhat cartilaginous, and they are not yet united to their Bones.

3. At eighteen or twenty Years of Age, the *Epiphyses* are entirely ossified, and have blended their Fibres so with the Body of the Bone, as to make them inseparable without Violence.

The

The Knowledge of this Part of the *Osteogeny*, I think necessary to prevent dangerous Mistakes in the Cure of several Diseases. As for Example: Without this Knowledge, the Separation of an *Epiphyse* might be mistaken for a Fracture or Luxation.—The Interstice of two Parts of a Bone not yet joined, might be judged to be a Fissure.—A *Diastasis*, or other violent Separation of such disjointed Pieces of a Bone, might be thought a Fracture.—The Protrusion of one Piece, or its overloping any other, could be mistaken for an Excrescence or *Exostosis*. Such Errors about the Nature of a Disease, would give one very different Indications of Cure, from what he would have, if he really understood his Patient's Case. And very often the Knowledge of the different Inequalities on the Surfaces of Bones, must direct us in the Execution of what is proper to be done to cure several of their Diseases.

Having thus considered the Bones when single, we ought next to shew the different Manner of their Junctions †. To express these, Anatomists have contrived a great Number of technical Terms; about the Meaning, Propriety and Classing of which, there has unluckily been Variety of Opinions. Some of these Terms it is necessary to retain, since they serve to express the various Circumstances of the Articulations.

D. 2

The

† Σύνταξις, σύνθεσις, συμβολή, ὁμιλία, Compositio, Connexio, Articulatio, Conjunctio, Nodus, Commissura, Structura, Compages.

The ARTICULATIONS are most commonly divided into three Classes, the *Symphysis*, *Synarthrosis*, and *Diarthrosis*.

The *Symphysis*, which properly signifies the Concretion or growing together of Parts, when used to express the Articulations of Bones, does not seem to comprehend, under the Meaning generally given to it, any thing relating to the Form or Motion of the conjoined Bones; but by it most Authors only denote the Bones to be connected by some other Substance; and as there are different Substances which serve this Purpose, therefore they divide it into the three following Species:

1. *Synchondrosis* *, when a Cartilage is the connecting Substance: Thus the Ribs are joined to the *Sternum*; thus the Bodies of the *Vertebræ* are connected to each other; as are likewise the *Ossa Pubis*.

2. *Synneurosis*, or *Syndesmosis*, when Ligaments are the connecting Bodies, as they are in all the moveable Articulations.

3. *Syffarcosis*, when Muscles are stretched from one Bone to another, as they must be where there are moveable Joints.

The second Class of Articulations, the *Synarthrosis*, which is said to be the general Term by which the immoveable Conjunction of Bones is expressed, is divided into three kinds.

1. The *Suture* † is that Articulation where two Bones are mutually indented into each other,

* Amphiarthrosis.

† *ῥαφή*.

other, or as if they were sowed together, and is formed by the Fibres of two Bones meeting while they are yet flexible and yielding, and have not come to their full Extent of Growth; so that they mutually force into the Interstices of each other, till, meeting with such Resistance as they are not able to overcome, they are stopped from sprouting out farther, or are reflected; and therefore these Indentations are very different both in Figure and Magnitude: Thus the Bones of the Head are joined; thus *Epiphyses* are joined to the Bones, before their full Connexion and Union with them.

Under this Title of *Suture*, the *Harmonia* of the Antients may be comprehended; scarce any unmoved Bones being joined by plain Surfaces (a).

2. *Gomphosis* * is the fixing one Bone into another, as a Nail is fixed in a Board: Thus the Teeth are secured in their Sockets.

3. *Schindylesis* or *Ploughing* (b), when a thin *Lamella* of one Bone is received into a long narrow Furrow of another: Thus the *Processus azygos* of the *sphenoid*, and the nasal Process of the *ethmoid* Bone, are received by the *Vomer*.

The *third* Class, or *Diarthrosis* †, is the Articulation where the Bones are so loosely
D. 3. connected.

(a) Vesal. Observ. Fallop. Examen.

* Conclavatio.

(b) Keil, Anat. chap. 5. §. 3.

† *Αναρθρώσις*, *Dearticulatio*, *Abarticulatio*.

connected as to allow large Motion. This is subdivided into three kinds.

The first is *Enarthrosis*, or the Ball and Socket, when a large Head is received into a deep Cavity; as the Head of the *Os Femoris* is into the *Acetabulum Coxendicis*.

The second is *Arthrodia*, when a round Head is received into a superficial Cavity; as in the Articulation of the Arm-bone and *Scapula*. Both this and the former sort of Articulation allow Motion to all Sides.

The third is *Ginglimus* †, which properly signifies the Hinge of a Door or Window; in it the Parts of the Bones mutually receive and are received, and allow of Motion two Ways: Workmen call it *Charnal*.

The *Ginglimus* is generally divided into three kinds, to which some (a) give the Names of *contiguus* †, *distant* †, and *compound* ‡.

The first kind of *Ginglimus* is, when a Bone has several Protuberances and Cavities, which answer to as many Cavities and Processes of the other Bone, with which it is articulated; as in the Conjunction of the *Femur* with the *Tibia*.

The second Species is, when a Bone receives another at one End, and is received by the same Bone at the other End; as in the *Radius* and *Ulna*.

The last sort is, when a Bone receives another,

* Articulatio mutua.

(a) Baker, Curf. Osteolog. Demonstr. 1.

† Proximus.

‡ Longus.

‡ Compositus.

another, and is received by a third; as in the oblique Processes of the *Vertebræ*.

When I first mentioned the Articulations of Bones, I said there were different Opinions concerning the Use of these technical Words applied to the Conjunctions of Bones, *e. g.*; It has been said, that *Symphysis* should be the Name for the immoveable Articulations, and that by *Synarthrosis* should be understood the Conjunction of Bones by some connecting *Medium*.—Those who have taken *Symphysis* in the Sense I did, of its expressing the Conjunction of Bones with a connecting Substance, have disagreed in their Definition of it; some inserting, and others leaving out, its allowing Motion.—Where they have agreed in their Definition, they have not been of the same Mind concerning the Species of it. For several think the *Sysarcosis* and *Syndesmosis* applicable to so many Joints which are universally allowed to be classed under the *Diarthrosis*, that it must create Confusion to name them by any Species of the *Symphysis*.—Few keep to such a general Definition of the *Synchondrosis* as I have done; and, whether they determine it to allow no Motion, or an obscure or a manifest one, bring themselves into Difficulties, because there are Examples of all these three kinds.—Some again, by too nicely distinguishing obscure and manifest Motions of Bones, have blended the *Synarthrosis* and *Diarthrosis*, and from thence have branched out the different compound Species of Articulations that may be formed

ed of them so far, that they could find no Examples in the Body to illustrate them by. —It would be tedious to enumerate more of the jarring Opinions, and it would be far more so to give a Detail of the Arguments used by the Disputants. It is sufficient for my Purpose that it is understood in what Sense I take these technical Terms; which I do in the following Manner.

When I mention the *Symphysis* or *Synarthrosis*, or any Species of them, I shall always understand them according to the Explication I have first given of them. But though the Account already given of the *Diarthrosis*, or Articulation of moveable Bones, has been almost universally received; yet seeing it does not comprehend all the moveable Articulations of the Body, and one of its Species does not answer to any Notion we can have of the Conjunction of two Bones, I must beg leave to change the Definitions and Kinds of these Joints.

I would call *Diarthrosis* that Conjunction of Bones, whereby they are fitted for Motion, being each covered with a smooth Cartilage, connected by one or more common Ligaments, and lubricated with *Synovia* at the conjoined Parts. In which Definition, I have no regard to the Quantity of Motion which they really do perform; the Motion being often confined or enlarged by some other Cause not immediately depending on the Frame of the two Surfaces of the Bones, forming the particular Joint, which then is considered.

The

The first Species of the *Diarthrosis*, viz. the *Enarthrosis* or Ball and Socket, I would define more generally than above, That Articulation where a round Head of one Bone is received into a Cavity of another, and consequently, without some foreign Impediment, is capable of Motion to all Sides. Examples of this kind are to be seen in the Articulation of the Thigh-bone and *Ossa innominata*; or the Arm-bone and *Scapula*; *Astragalus* and *Os Naviculare*; *Magnum*, or *Capitatum* of the Wrist, with the *Scaphoides*. and *Lunare*; first Bone of the Thumb with the second, &c.

The second Sort, or the *Arthrodia*, differing from the *Enarthrosis*, in the preceeding Account, only in the Cavity's being more superficial, which makes no essential Difference, especially that, in the recent Subject, Cartilages or Ligaments supply the Deficiency of Bone, ought, in my Opinion, to be called, with *Vesalius* (a), that Articulation of two Bones adapted for Motion, where it is not at first Sight obvious which of the two has the Head or Cavity, or where they are joined by plain Surfaces, or nearly so; such is the Conjunction of the *Clavicle* with the *Scapula*; *Ossa Cuneiformia* with the *Os Naviculare*; *Metatarsal* Bones with the *Ossa Cuneiformia*, &c. From the Nature of this sort of Joint, it is plain, that very great Motion cannot be allowed, without the Bones going farther out of their natural Situation, than is convenient or safe.

Ginglimus

(a) De corp. human. fabrica, lib. i. cap. 4.

Ginglimus, I would reckon that Articulation by the Form of which the Motion of the joined Bones must be chiefly confined to two Directions, which Hinges of Doors are.

The first Species of this is the *Trochoides*, when the one Bone turns on the other, as a Wheel does on its Axis: Thus the first *Vertebra* of the Neck moves on the Tooth-like Process of the second. This is the most proper kind of *Ginglimus*.

The second Species should be esteemed that Articulation, where several prominent and hollow Surfaces of two Bones move on each other, within the same common Ligament; as in the Knee, Elbow, &c.

The third Sort of *Ginglimus* is, when two Bones are articulated to each other at different Parts, with a distinct *Apparatus* of the motory Machines at each; such is the Articulation of the *Os Occipitis* with the first *Vertebra* of the Neck, of any two contiguous *Vertebrae* by their oblique Processes, of the Ribs with the Bodies and transverse Processes of the *Vertebrae*, of the *Radius* with the *Ulna*, *Tibia* with the *Fibula*, *Astragalus* with the *Calcaneum*, &c.

I would entirely throw out what is commonly called the third kind of *Ginglimus*: For, in examining the Conjunction of a Bone with two others, as in the common Example of a *Vertebra* joined with the one above and below, the Connexion of the middle one with each of the other two, ought to be considered separately; otherwise

wise we might with the same Propriety esteem the Articulations that the long Bones, the *Femur*, *Tibia*, *Humerus*, &c. have at their different Ends, as one Articulation; which is absurd.

If the moveable Bones were not connected and kept firm by some strong Substance, they would be luxated at every Motion of the Joints; and if their hard rough unequal Surfaces were to play on each other, their Motion would not only be difficult, but the Loss of Substance from Attrition would be great: Therefore *Ligaments* are made to obviate the first, and *Cartilages* to prevent the other Inconveniency. But because Ligaments and Cartilages turn rigid, inflexible and rough, unless they are kept moist, a sufficient Quantity of proper Liquors is supplied for their Lubrication, and to preserve them in a flexible State. Seeing then these Parts are so necessary to the Articulations, I shall next consider their Structure, Situation and Uses, so far as they are subservient to the Bones, and their Motions.

LIGAMENTS * are white flexible Bodies, thicker and firmer than Membranes, and not so hard or firm as Cartilages, without any remarkable Cavity in their Substance, difficultly stretched, and with little Elasticity; serving to connect one Part to another, or to prevent the Parts to which they are fixed from being removed out of that Situation; which is useful and safe.

After

* Σύνδεσμοι, νεῦροι, Copulæ, Vincula.

After Maceration in Water, the Ligaments can easily be divided; and each ligamentous Layer appears composed of Fibres, the largest of which are disposed in a longitudinal Direction.

The *Arteries* of Ligaments are very conspicuous after a tolerable Injection, and the larger Trunks of their Veins are sometimes to be seen full of Blood.

Such Ligaments as form the Sides of Cavities, have numerous Orifices of their Arteries opening upon their internal Surface, which keep it always moist: If we rub off that Moisture, and then press the Ligament, we can see the Liquor ousing out from small Pores; and we can force thin Liquors, injected by the Arteries, into the Cavities formed by Ligaments.

These exhalant Arteries must have corresponding absorbent *Veins*, otherwise the Cavities would soon be too full of Liquor.

Ligaments then must be subject to the Diseases common to other Parts, where there is a Circulation of Fluids.

Authors generally say, That Ligaments are insensible; and consequently it may be inferred, that they have no Nerves bestowed on them. But the violent racking Pain felt on the least Motion of a Joint labouring under a *Rheumatism*, the Seat of which Disease seems often to be in the Ligaments, and the insufferable Torture occasioned by a Collection of acrid Matter in a Joint, or by *Tophi* in the Gout, would persuade us, that

that they are abundantly supplied with Nerves.

The Ligaments, which serve to connect the moveable Bones, commonly rise from the Conjunction of the *Epiphyses* of the one Bone, and are inserted into the same Place of the other; or where *Epiphyses* are not, they come out from the *Cervix*, and beyond the *Supercilia* of the articulated Bones; and after such a Manner, in both Cases, as to include the Articulation in a Purse or Bag, with this Difference, depending on their different Motions, that where the Motion is only to be in two Directions, the Ligaments are strongest on those Sides towards which the Bones are not moved; and when a great Variety of Motions is designed to be allowed, the Ligaments are weaker than in the former sort of Articulations, and are nearly of the same Strength all round.

Besides these common capsular Ligaments of the Joints, there are particular ones in several Places, either for the firmer Connexion of the articulated Bones, or for restraining and confining the Motion to some one Side; such are the *cross* Ligaments of the Ham, the *round* one of the Thigh, &c.

From this Account of the Ligaments, we may conclude, that, *cæteris paribus*, in whatever Articulation, the Ligaments are few, long and weak, the Motion is more free and quick; but Luxations happen frequently: And, on the contrary, where the

E

Ligaments

Ligaments are numerous, short and strong, the Motion is more confined; but such a Joint is less exposed to Luxations (a). Whence we may judge how necessary it is to attend to the different Ligaments, and the Changes which have been made on them by a Luxation when it is to be reduced.

Ligaments also supply the Place of Bones in several Cases to Advantage: Thus the Parts in the *Pelvis* are more safely supported below by Ligaments, than they could have been by Bone.—The Ligaments, placed in the great Holes of the *Ossa innominata*, and between the Bones of the Fore-arm and Leg, afford convenient Origin to Muscles.—Immoveable Bones are firmly connected by them; of which the Conjunction of the *Os sacrum* and *Os innominata* is an Example.—They afford a Socket for moveable Bones to play in, as we see Part of the *Astragalus* does on the Ligaments stretched from the Heel-bone to the *Scaphoid* Bone.

CARTILAGES * are solid, smooth, white, elastick Substances, between the Hardness of Bones and Ligaments, and covered with a Membrane, named *Perichondrium*, which is of the same Structure and Use to them, as the *Periosteum* is to the Bones.

Cartilages are composed of Plates, which are formed of Fibres, disposed much in the same way as those of Bones are; as
might

(a) *Fabric. ab Aquapend. de Articul. Part. utilit. Pars 3.*
* *Xarēpoi.*

might be reasonably concluded, from observing Bones in a cartilaginous State before they ossify, and from seeing, on the other hand, so many Cartilages become bony. This may be still farther confirmed, by the *Exfoliation* which Cartilages are subject to, as well as Bones; and a Demonstration can be given of this Structure, after boiling, burning, and exposing Cartilages to the Weather.

Blood-vessels and Nerves are distributed to Cartilages, in much the same Manner as to Bones.

While Cartilages are in a natural State, it is to be remarked, *first*, That they have no Cavity in their Middle for Marrow. *Secondly*, That their outer Surface is softest, which renders them more flexible; from this it is, that injected Liquors easily fill the Vessels on their Surface, but seldom reach to their middle solid Part. And, *lastly*, That, as the specific Gravity of Cartilages is near a third less than that of Bones; so the Cohesion of their several Plates is not so strong as in Bones: Whence Cartilages laid bare in Wounds or Ulcers; are not only more liable to corrupt, but exfoliate much sooner than Bones do.

Cartilages seem to be principally kept from ossifying, either by being subjected to alternate Motions of Flexion and Extension, the Effects of which are very different from any kind of simple Pressure, or by being constantly moistened: Thus,

the Cartilages on the articulated Ends of the great Bones of the Limbs, and the moveable ones placed between the moving Bones in some Articulations, which are obliged to suffer many and different Flexions, and are plentifully moistened, scarce ever change into Bone; while those of the Ribs and Larynx are often ossified.—The middle angular Part of the Cartilages of the Ribs, which is constantly in an alternate State of Flexion and Extension, by being moved in Respiration, is always the last of becoming bony.—In the *Larynx*, the *Epiglottis*, which is oftener bended and more moistened than the other four Cartilages, seldom is ossified, while the others as seldom escape it in Adults.—Hence we may know what the Annihilation is, which is said to be made of the Head of a Bone, and of the Cavity for lodging it, after an unremoved Fracture (a).

Cartilages begin to ossify on their external Surface, unless when Moisture or Flexion impede it, and the Ossification proceeds internally, till the *Cancelli* are at last formed, when Marrow is deposited into them. While this Change is a bringing about in the Substance of Cartilages, their Blood-vessels gradually appear bigger towards their internal Substance, and less on the external. This Change of a Cartilage from a natural State, to its becoming

(a) *Ruyseh. Thesaur. 8. Num. 103. Saltzman. in Act. Petropolit. Tom. 3. p. 275.*

coming Bone, is at first view surprising; and, so far as I know, none has attempted to explain it; which I mention only, to have some Plea for an Apology, if I should be thought to have failed in accounting for this *Phænomenon*.

The Cartilages, being naturally of such firm Substance, and of a Composition akin to that of Bones, gradually acquire greater Solidity by constant Pressure; and this Change is made soonest and most remarkably where the Pressure is greatest; that is, at their external Surface.—The exterior Plates, when ossified, are more compact and dense than formerly, and therefore have a stronger Power of attracting those in Contact with them; while the Branches of Vessels distributed to the first ossified Plate, and those that run in the Interstices of the Fibres of this and of the Plate next to it, being now more compressed than formerly, have a less Quantity of Fluids passing through them; and, consequently, the other Branches receive a proportionally larger Quantity; the *Momentum* of which, joined to that Power of Attraction or Force of Cohesion, increased by the greater Solidity of the Plates, increases the Pressure upon the more internal Plates; and hastens their Hardening; after which these last Plates produce the same Effects on the other contiguous to them: And thus the Ossification goes on, till all are become bony.—The Body thus changed, has its former Dimen-

E. 2 sions

sions, or nearly so; because its external Part ossified first, and being rigid, yields little or nothing to the Powers that draw it towards the Axis of the Bone. But seeing the new Particles, added from the circulating Fluids, during the Ossification, do not compensate for the Condensation which all the Particles undergo, and thereby the Plates occupy less Space than they did while in a cartilaginous State, a Cavity is left in the Middle. And as all the Plates cohered, and had cross Fibres joining them, many of these Fibres are stretched irregularly from one Side of the Cavity to the other, and therefore form *Cancelli*. — The Branches of the Vessels formerly distributed to the Plates being now much lessened, the remaining Branches, which run transversely, are consequently proportionally increased, become very conspicuous, and are dispersed every where in the Cavity, to serve for the Secretion of Marrow. — Thus, this flexible elastick solid Substance, becomes a rigid inflexible cavernous Bone, with Marrow contained in its *Cancelli*.

The Cartilages subservient to Bones, are sometimes found on the Ends of Bones which are joined to no other; but are never wanting on the Ends and in the Cavities of such Bones as are designed for Motion (a). Cartilages also are interposed between such other Cartilages as cover the

(a) *Cels. de re Medic. lib. 8. cap. 1.*

the Heads and Cavities of articulated Bones; nay they are also placed between immoveable Bones.

The Uses of Cartilages, so far as they regard Bones, are, to allow, by their Smoothness, such Bones as are designed for Motion, to slide easily without Detriment, while, by their Flexibility, they accommodate themselves to the several Figures necessary in different Motions, and, by their Elasticity, they recover their natural Position and Shape, as soon as the Pressure is removed.—This springy Force may also assist the Motion of the Joint to be more expeditious.—To these Cartilages we chiefly owe the Security of the moveable Articulations: For without them the bony Fibres would sprout out, and intimately coalesce with the adjoining Bone; whence a true *Anchylosis* must necessarily follow; which never fails to happen when the Cartilages are eroded, as was already observed.—The moveable Cartilages interposed in Joints, serve to make the Motions both freer and more safe than they would otherwise be.—Those placed on the Ends of Bones that are not articulated, as, on the *Spine* of the *Ilium*, Base of the *Scapula*, &c. serve to prevent the bony Fibres from growing out too far.—Cartilages sometimes serve as Ligaments, either to fasten together Bones that are immoveably joined, such are the Cartilages between the *Os sacrum*, and *Ossa Ilium*, the *Ossa Pubis*, &c. or to connect
Bones

Bones that enjoy manifest Motion, as those do which are placed between the Bodies of the true *Vertebræ*, &c.—Cartilages very often do the Office of Bones to greater Advantage than these last could; as in the Cartilages of the Ribs, the Cartilages which supply Brims of Cavities, &c.

The Liquor, which principally serves to moisten the Ligaments and Cartilages of the Articulations, is supplied by Glands, which are commonly situated in the Joint, after such a Manner, as to be gently pressed, but not destroyed by its Motion. By this means, when there is the greatest Necessity for this Liquor, that is, when the most frequent Motions are performed, the greatest Quantity of it must be separated. These Glands are soft and pappy, but not friable: They are mostly of the conglomerate kind, or a great Number of small Glandules are wrapt up in one common Membrane. Their excretory Ducts are long, and hang loose, like so many Fringes, within the Articulation; which, by its Motion and Pressure, prevents Obstructions in the Body of the Gland, or its Excretories; and promotes the Return of this Liquor, when fit to be taken up by the absorbent Vessels, which must be in the Joints, as well as in the other Cavities of the Body; and, at the same time, the Pressure on the excretory Ducts hinders a superfluous unnecessary Secretion, while the fimbriated Disposition of these Excretories does not allow any of the secreted Liquor to be
pushed

pushed back again by these Canals towards the Glands (a).

Besides these conglomerate Glands in the Joints, there are sometimes small simple *Folliculi*, that are full of Liquor (b).

Upon pressing any of these Glands with the Finger, one can squeeze out of their Excretories a mucilaginous Liquor, which somewhat resembles the White of an Egg, or *Serum* of the Blood; but it is manifestly salt to the Taste. It does not coagulate by Heat, as the *Serum* does; but turns first thinner, and, when evaporated, leaves only a thin salt Film. Different Salts have much the same Effect on it as on many other Juices of our Body; for *Acids* coagulate it, and *Alkalies* attenuate it. The Quantity of this *Mucilage*, constantly supplied, must be very considerable, since we see what a plentiful troublesome Discharge of *Synovia* follows a Wound or Ulcer of any Joint; of which Liquor the Mucilage is a considerable Part.

The Vessels which supply Liquors for making the Secretion of this Mucilage, and the Veins which bring back the Blood remaining after the Secretion, are to be seen without any Preparation; and, after a tolerable Injection of the Arteries, the Glands are covered with them.

In a sound State, we are not conscious of any Sensibility in those Glands; but, in some Cases which I have seen, when they inflame

(a) *Cowper*, Anatomy Explicat. tab. 79. litt. E. E.

(b) *Morgagn*. Adversat. 2, Animad. 23.

inflammation and suppurate, the most racking Pain is felt in them: A melancholly, though a sure Proof that they have Nerves.

These mucaginous Glands are commonly lodged in a cellular Substance; which is also to be observed in other Parts of the Bag formed by the Ligaments of the Articulation; and contains a fatty Matter, that must necessarily be attenuated, and forced through the including Membranes into the Cavity of the Joint, by the Pressure which it suffers from the moving Bones.

If then the Oil is conveyed from this cellular Substance; and if the attenuated Marrow passes from the *Cancelli* of the Bones by the large Pores near their Ends, or in their Cavities, and sweats through the Cartilages there into the Articulations; which it may, when assisted by the constant Heat and Action of the Body, more easily do, than when it escapes through the compact Substance of the Bones in a Skeleton: If, I say, this Oil is sent to a Joint, and is incorporated with the Mucilage, and with the fine Lymph that is constantly issuing out at the Extremities of the small Arteries distributed to the Ligaments, one of the fittest *Linaments* imaginable must be produced; for the *Mucus* diluted by the Lymph contributes greatly to its Lubricity, and the Oil preserves it from hardening. How well such a Mixture serves the Purpose it is designed for, *Boyle* (a) tells us he experienced in working his Air-pump; for the

(a) Physico-mechanic. Experim.

the Sucker could he moved with much less Force, after being moistened with Water and Oil, than when he used either one or other of these Liquors: And I believe every one, at first View, will allow the diluted Mucilage to be much preferable to simple Water. The *Synovia*, as this Liquor composed of Oil and Mucilage is commonly called, while in a sound State, effectually preserves all the Parts concerned in the Articulations soft and flexible, and makes them slide easily on each other, by which their mutual Detrition and Overheating is prevented, in the Manner daily practised in Coach and Cart Wheels, by besmearing them with Grease and Tar.

After the Liquor of the Articulations becomes too thin and unserviceable, by being constantly pounded and rubbed between the moving Bones, it is reassumed into the Mass of Blood by the absorbent Vessels.

When the *Synovia* is not rubbed betwixt the Bones, it inspissates. And sometimes, when the Head of a Bone has been long out of its Cavity, this Liquor fills up the Place of the Bone, and hinders its Reduction; or if a Joint continues long unmoved, the *Synovia* cements the Bones, and occasions a true *Achylosis* (a).—If the *Synovia* becomes too acrid, it erodes the Cartilages and Bones; as frequently happens to those who labour under the *Lues Venerea*, *Scurvy*, *Scrophulæ*, or *Spina ventosa*.—If
this

(a) *Parè*, Chirurgie. livre 15. chap. 18.

this Liquor is separated in too small a Quantity, the Joint becomes stiff; and when with Difficulty it is moved, a crackling Noise is heard, as People advanced in Years frequently experience (a).—If the Mucilage and Lymph are deposited in too great a Quantity, and the absorbent Vessels do not perform their Office sufficiently, they may occasion a Dropsy of the Joints (b).—From this same Cause also the Ligaments are often so much relaxed, as to make the Conjunction of the Bones very weak: Thence arise the Luxations from an internal Cause, which are easily reduced, but difficultly cured (c).—Frequently, when such a superfluous Quantity of this Liquor is pent up, it becomes very acrid, and occasions a great Train of bad Symptoms; such as Swelling and Pain of the Joints, long sinuous Ulcers and *Fistulæ*, rotten Bones, Immobility of the Joints, *Marcor* and *Atrophia* of the whole Body, hectic Fevers, &c. (d).

T H E

(a) *Galen. de usu Part. lib. 12. cap. 2.*—*Fabric. ab Aquapend. de Articul. part. utilitat. pars 3.*—*Bartholin. Hist. medic. Cent. 3. Hist. 17.*

(b) *Hildan. de Ichore & Meliceria acri Celsi.*

(c) *Hippocrat. de locis in homine, § 14. & de Articul.*

(d) *Hildan. de Ichore & Meliceria acri Celsi.*

THE
ANATOMY
OF THE
HUMAN BONES.

PART II.

Of the SKELETON.

THOUGH any dry Substance may be called *Skeleton*, yet, among Anatomists, this Word is universally understood to signify the Bones of Animals connected together, after the Teguments, Muscles, Bowels, Glands, Nerves, and Vessels are taken away *.

A *Skeleton* is said to be a *natural* one, when the Bones are kept together by their own Ligaments; and it is called *artificial*, when the Bones are joined with Wire, or any other Substance which is not Part of the Creature to which they belonged. Small

F Subjects,

* Cadaveris crates.

Subjects, and such whose Bones are not fully ossified, are commonly prepared the first Way; because, were all their Parts divided, the nicest Artist could not rejoin them, by reason of their Smallness, and of the Separation of their unossified Parts; whereas the Bones of large adult Animals are soonest and most conveniently cleaned when single, and are easily restored to, and kept in their natural Situation.—Sometimes the Skeleton of the same Animal is prepared in both these Ways; that is, we leave the smaller Bones joined by their natural Ligaments, and the larger ones are connected by Wires, or some such Substances.

Before we proceed to the Division and particular Description of the Skeleton, it is worth while to remark, that when the Bones are put into their natural Situation, scarce any one of them is placed in a perpendicular Bearing to another; though the Fabrick composed of them is so contrived, that, in an erect Posture, a perpendicular Line, from their common Center of Gravity, falls in the Middle of their common Base (*a*). On this account, we can support ourselves as firmly, as if the Axis of all the Bones had been a streight Line perpendicular to the Horizon; and we have much greater Quickness, Ease and Strength in several of the most necessary Motions we perform. It is true indeed, that where-ever the Bones, on which any Part of our Body is sustained, decline from a streight Line,

the

(*a*) *Cowper*, *Anat. of human Bodies*, Explic. of Tab. 87. 88.

the Force required in the Muscles to counteract the Gravity of that Part, is greater than otherwise it needed to have been: But then this is effectually provided for in such Places, by the Number and Strength of the Muscles. As long therefore as we remain in the same Posture, a considerable Number of Muscles must be in a constant State of Contraction; which we know, both from Reason and Experience, must soon create an uneasy Sensation. This we call, being weary of one Posture: An Inconvenience that we should not have had in standing erect, if the Bearing of all the Bones to each other had been perpendicular; but is more than compensated by the Advantages above mentioned.

The human Skeleton is generally divided into the HEAD, the TRUNK, the SUPERIOR and the INFERIOR EXTREMITIES.

Of the HEAD.

BY the *HEAD* is meant all that spheroidal Part which is placed above the first Bone of the Neck. It therefore comprehends the *Cranium* and Bones of the *Face*.

The *Cranium**, Helmet, or Brain-case, consists of several Pieces; which form a vaulted Cavity, for lodging and defending the Brain, *Cerebellum*, Membranes and Vessels.

The Cavity of the *Cranium* is proportioned to its Contents. Hence such a Variety

F 2

of

* Κορυχός, κύριος, κάσκεις, σκαπίον, calva, cavaria, cerebri galza, theca & olla capitis, testa capitis, scutella capitis.

of its Size is observed in different Subjects; and hence it is neither so broad nor so deep at its Fore-part, in which the anterior Lobes of the Brain are lodged, as it is behind, where the large posterior Lobes of the Brain, and the whole *Cerebellum*, are contained.

The roundish Figure of the Scull, which makes it more capacious, and better able to defend its Contents from external Injuries, is chiefly owing to the equal Pressure of these contained Parts, as they grow and increase before it is entirely ossified.—It is to be observed, however, that in Adults the Sides of the *Cranium* are depressed below a spherical Surface by the strong temporal Muscles, whose Action hinders here the uniform Protrusion of the Bones, which is more equally performed in other Parts, where no such large Muscles are. In Children, whose Muscles have not acted much, and consequently have not had great Effects on the Bones, this Depression is not so remarkable; and therefore their Heads are rounder than in Adults. These natural Causes, differently disposed in different People, produce a great Variety in the Shapes of Sculls, which is still increased by the different Management of the Heads of Children when very young: So that one may know a *Turk's* Scull by its globular Figure, a *German's* by its Breadth and Flatness of the *Occiput*, *Dutch* and *English* by their oblong Shapes, &c. (a). Two Advantages are produced from this Flatness of the Sides of the

(a) *Vesal. Lib. 1. cap. 5.*

the *Cranium*, viz. the Enlargement of our Sphere of Vision, and more advantageous Situation of our Ears, for receiving a greater Quantity of Sound, and for being less exposed to Injuries.

The external Surface of the upper Part of the *Cranium* is very smooth and equal, being only covered with the *Periosteum*, (common to all the Bones, but, in the Skull, distinguished by the Name of *Pericranium*), the thin *frontal* and *occipital* Muscles, their tendinous *Aponeurosis*, and with the common Teguments of the Body; while the external Surface of its lower Part is all over full of Risings, Depressions and Holes, which afford convenient Origin and Insertion to the Muscles that are connected to it, and allow safe Passage for the Vessels and Nerves that run through and near it.

The internal Surface of the upper Part of the Skull is commonly smooth, except where the Vessels of the *Dura Mater* have made Furrows in it, while the Bones were soft. --Surgeons should be cautious when they trepan here, lest, in sawing or raising the Bone where such Furrows are, they wound the Vessels of the *Dura Mater*.—In the upper Part of the internal Surface of several Skulls, there are likewise Pits of different Magnitudes and Figures, which seem to be formed by some Parts of the Brain being more luxuriant and prominent than others. Where these Pits are, the Skull is so much thinner than any where else, that it is often rendered diaphanous, the two Tables being closely

compacted without a *Diploe*; the want of which is supplied by Vessels going from the *Dura Mater* into a great many small Holes observable in the Pits. These Vessels are larger, and much more conspicuous than any others that are sent from the *Dura Mater* to the Scull; as evidently appears from the Drops of Blood they pour out, when the Scull is raised from the *Dura Mater* in a recent Subject; and therefore they may furnish a sufficient Quantity of Liquors necessary to prevent the Brittleness of this thin Part.—The Knowledge of these Pits should teach Surgeons, to saw cautiously and slowly, through the external Table of the Scull, when they are performing the Operation of the *Trepan*; since, in a Patient whose *Cranium* has these Pits, the *Dura Mater* and Brain may be injured, before the Instrument has pierced near the ordinary Thickness of a Table of the Scull.—The internal Base of the Scull is extremely unequal, for lodging the several Parts and *Appendices* of the Brain and *Cerebellum*, and allowing Passage and Defence to the Vessels and Nerves that go into, or come out from these Parts.

The Bones of the *Cranium* are composed of two Tables, and intermediate *Cancelli*, commonly called their *Diploe*†. The external Table is thickest; the inner, from its Thinness and consequent Brittleness, has got the Name of *Vitrea*. Whence we may see the Reason of those mischievous Consequences,

† Meditullium, commissura.

Consequences, which so often attend a Collection of Matter in the *Diploe*, either from an external or internal Cause, before any Sign of such a Collection appears in the Teguments that cover the Part of the Scull where it is lodged (a).

The *Diploe* has much the same Texture and Uses in the Scull, as the *Cancelli* have in other Bones.

The *Diploe* of several old Subjects is so obliterated, that scarce any Vestige of it can be seen; neither is it observable in some of the hard craggy Bones at the Base of the Scull. Hence an useful Caution to Surgeons who trust to the Bleeding, Want of Resistance, and Change of Sound, as certain Marks in the Operation of the Trepan, for knowing when their Instrument has sawed through the first Table, and reached the *Diploe*.—In other People, the *Diploe* becomes of a monstrous Thickness, while the Tables of the Scull are thinner than Paper.

The *Cranium* consists of eight Bones, six of which are said to be proper, and the other two are reckoned common to it and to the Face.—The six proper are the *Os frontis*, two *Ossa parietalia*, two *Ossa temporum*, and the *Os occipitis*.—The common are the *Os Ethmoides* and *Sphenoides*.

The *Os frontis* forms the whole Fore-part of the Vault; the two *Ossa parietalia* form the upper and middle Part of it; the *Ossa temporum* compose the lower Part of the Sides; the

(a) Bonet. Sepulchret. Anat. lib. 1. § 1. obs. 96.---103.

the *Os occipitis* makes the whole hinder Part, and some of the Base; the *Os Ethmoides* is placed in the Fore-part of the Base, and the *Os Sphenoides* is in the Middle of it.

These Bones are joined to each other by five *Sutures*; the names of which are the *Coronal*, *Lambdoid*, *Sagittal*, and two *Squamous*.

The *Coronal* † Suture is extended over the Head, from within an Inch or so of the external *Canthus* of one Eye, to the like Distance from the other; which being near the Place where the Antients wore their *Vittæ Coronæ*, or Garlands, this Suture has hence got its Name.—Though the Indentations of this Suture are conspicuous in its upper part, yet an Inch or more of its End on each Side has none of them; for it is squamous and smooth there.

The *Lambdoidal* ‡ Suture begins some way below, and farther back than the *Vertex* or Crown of the Head, whence its two Legs are stretched obliquely downwards, and to each Side, in form of the *Greek* Letter Δ , and are now generally said to extend themselves to the *Base* of the Scull; but formerly Anatomists (a) reckoned the proper *Lambdoid* Suture to terminate at the *Squamous* Sutures, and what is extended at an Angle down from that on each Side, where the Indentations are less conspicuous than in the upper Part of the Suture they called *Additamentum futuræ Lambdoidis* *.

This

† *Στεφανία*, Arcualis, Puppis.

‡ *Lambdoides harmonialis*, *Lambdoides inferior*, *Occipitis Cornua*,

* *Laudæ*, *Proræ*, *Hypfyloides*.

This *Suture* is sometimes very irregular, being made up of a great many small *Sutures*, which surround so many little Bones that are generally larger and more conspicuous on the external Surface of the Scull, than internally. These Bones are generally called *Triquetra* or *Wormiana*; but some other Name ought to be given them, for they are not always of a triangular Figure; and older Anatomists (*a*) than *Olaus Wormius* (*b*) have described them. — The specifick Virtue which these Bones were once thought to have in the Cure of the Epilepsy (*c*) is not now ascribed to them; and Anatomists generally agree, that their Formation is owing to the ordinary Bones of the *Cranium* not extending their Ossification far enough or soon enough; in which Case, the unossified Interstice between such Bones begins a separate Ossification in one or more Points; from which the Ossification is extended to form as many distinct Bones as there were Points, that are indented into the large ordinary Bones, and into each other. — Probably those Children who have a large Opening in this Place at their Birth, will have the largest *Ossa Triquetra*. — To confirm this Account of the Formation of these little Bones, we may remark, that such Bones are

(*a*) *Eustach.* Ossium Examen. — *Bauhin.* Theat. Anat. lib. 3. cap. 5. — *Paaw* in Hippocrät. de Vulner. cap. p. 56.

(*b*) *Musæum*, lib. 3. cap. 26.

(*c*) *Bauhin.* & *Paaw*, *ibid.* — *Bartholin.* Anat. reform. lib. 4. cap. 5. — *Hildan.* Epistol. 65.

are sometimes seen in other Sutures, as well as in the *Lambdoid* (a), and they are sometimes in one Table of the Skull, and not in the other (b).

The *Sagittal* Suture * is placed longitudinally in the middle of the upper Part of the Skull, and commonly terminates at the middle of the *Coronal* and of the *Lambdoid* Sutures; between which it is said to be placed, as an Arrow is between the String and Bow.—However this Suture is frequently continued through the Middle of the *Os frontis*, down to the Root of the Nose; which, some (c) say, oftener happens in Women than Men; but others (d) alledge, that it is to be met with more frequently in Male Skulls, than in Female: Among the Skulls which I have seen thus divided, the Female are the most numerous.—Several (e) have delineated and described the *Sagittal* Suture, sometimes dividing the *occipital* Bone as far down as the great Hole through which the *Medulla Spinalis* passes. This I never saw.

In

(a) See Examples in *Vesal*. lib. 1. cap. 6. fig. 4.--*Paaw* in Hippocrat. de cap. Vuln.----*Ruyfch*, Mus. Anat.----*Bartholin*. Hist. Anat. Cent. 1. Hist. 51.

(b) *Hunauld*. in Mem. de l' Acad. des Sciences, 1730.

* *ῥαβδωδὴς, ὀβελαια, ἐπιευγῦσα*, Instar virgae, nervalis, instar teli, instar veru, secundum capitis longitudinem prorpens, conjungens, columnalis, recta, acualis.

(c) *Riolan*. Comment. de Ossib. cap. 8.

(d) *Vesal*. Lib. 1. cap. 6. et in Epitome.

(e) *Vesal*. Lib. 1. cap. 5. fig. 3. 4. et in Text. cap. 6.--*Paaw* in Cels. de re medic. cap. 1.----*Laurent*. Hist. Anat. lib. 2. cap. 16.

In some old Skulls that are in my Possession, there is scarce a Vestige of any of the three *Sutures* which I have now described. In other Heads, one or two of the *Sutures* only disappear; but I never could discover any Reason for thinking them disposed in such different Manners in Skulls of different Shapes, as some Antients alledge they are (a).

The *Squamous Agglutinations*, or *False Sutures* *, are one on each Side, a little above the Ear, of a semicircular Figure, formed by the overlapping (like one Scale upon another) of the upper Part of the *temporal* Bones on the lower Part of the *parietal*, where, in both Bones, there are a great many small Risings and Furrows, which are indented into each other; though these Inequalities do not appear till the Bones are separated. In some Skulls indeed the Indentations here are as conspicuous externally as in other *Sutures* (b); and what is commonly called the posterior Part of this *squamous Suture*, always has the evident serrated Form; and therefore is reckoned by some (c) a distinct *Suture*, under the Name of *Additamentum posterius suturæ squamosæ*.—I have seen two *squamous Sutures*

(a) *Hippocrat. de Vulner. Capitis*, § 1.----*Galen. de Offib. & de usu Part. lib. 9. cap. 17.*

† Λεπιδοειδῆ, προσκολληµατα, χροταφῖαι, *Temporales, Corticales, Mendosæ, Harmoniales, Commissuræ in unguem.*

(b) *Columb. de re Anat. lib. 1. cap. 4.*----*Dionis, Anat. 3. Demonstr. des Os.*

(c) *Albin. de Offib. § 54.*

tures on the same Temple, with a semicircular Piece of Bone between them.

We ought here to remark, that the true squamous sort of Suture is not confined to the Conjunction of the temporal and parietal Bones, but is made use of to join all the Edges of the Bones on which each temporal Muscle is placed (a): For the two Parts of the sphenoidal Suture which are continued from the anterior End of the common squamous Suture just now described, of which one runs perpendicularly downwards, and the other horizontally forwards, and also the lower Part of the coronal Suture already taken notice of, may all be justly said to pertain to the squamous Suture.—The Manner how I imagine this sort of Suture is formed at these Places, is, That, by the Action of the strong temporal Muscles on one Side, and by the Pressure of the Brain on the other, the Bones are made so thin, as to admit of no other Suture. The *squamous* Form is also more convenient here; because such thin Edges of Bones, when accurately applied one to another, have scarce any rough Surface, to obstruct or hurt the Muscle in its Contraction; which is still further provided for, by the Manner of laying these Edges on each other; for, in viewing their Outside, we see the temporal Bones covering the sphenoidal and parietal, and this last supporting the sphenoidal, while both
mount

(a) *Vesal. Anat. lib. 1. cap. 6. --- Winslow, Mem. de l'Acad. des Sciences, 1720.*

mount on the Frontal: From which Disposition it is evident, that while the temporal Muscle is contracting, which is the only Time it presses strongly in its Motion on the Bones, its Fibres slide easily over the external Edges. Another Advantage still in this is, that all this bony Part is made stronger by the Bones thus supporting each other.

The Bones of the Scull are joined to each other, and also to those of the Face, by *Schyndeles* and *Sutures*.—The *Schyndeles* is in the Partition of the Nose.—The *Sutures* common to the *Cranium* and Face are five, viz. the *Ethmoidal*, *Sphenoidal*, *Transverse*, and two *Zygomatic*.

The *Ethmoidal* and *Sphenoidal* Sutures surround the Bones of these Names; and in some Places help to make up other Sutures, particularly the *Squamous* and *Transverse*; and in other Parts there is but one Suture common to these two Bones.

The *Transverse* Suture runs quite cross the Face, from the external *Canthus* of one Orbit to the same Place of the other, by sinking from the *Canthus* down the Outside of the Orbit to its Bottom; then mounting upon the Inside, it is continued by the Root of the Nose down the internal Part of the other Orbit, and up again to the other *Canthus*. It may be here remarked, that there are some Interruptions of this Suture in the Course I have described; as the Bones are not contiguous every where, but are separated, to leave

G

Holes

Holes and Apertures, to be mentioned hereafter.

The *Zygomatic Sutures*—are one on each Side, being short and slanting from above obliquely downwards and backwards, to join a Process of the Cheek-bone to one of the *temporal Bone*, which advances towards the Face; so that the two Processes thus united, form a sort of Bridge, or *Jugum*, under which the *temporal Muscle* passes; on which account the Processes, and Suture joining them, have been called *Zygomatic*.

It must be observed, that the Indentations of the *Sutures* do not appear on the Inside of the *Cranium*, by much so strong as on the Outside, but the Bones seem almost joined in a straight Line; nay, in some Skulls, the internal Surface is found entire, while the *Sutures* are manifest without; which may possibly be owing to the less Extent of the concave than of the convex Surface of the *Cranium*, whereby the Fibres of the internal Side would be stretched farther out at the Edges of the Bones, than the exterior ones, if they were not resisted. The Resistances are the Fibres of the opposite Bone, the Parts within the Skull, and the *Diploe*; of which the last being the weakest, the most advanced Fibres or *Serræ* run into it, and leave the contiguous Edges equal, and more ready to unite: Whereas the *Serræ* of the external Table have Space enough for their Admission between the Fibres of the opposite Bone; and therefore remain of the indented Form, and are less liable

liable to the Concretion, whereby the Sutures are obliterated (a). — By this Mechanism, there is no Risk of the sharp Points of the Bones growing inwards, since the external *Serræ* of each of the conjoined Bones rest upon the internal smooth-edg'd Table of the other; and external Forces applied to these Parts are strongly resisted, because the Sutures cannot yield, unless the serrated Edges of the one Bone, and the plain internal Plate of the other are broken (b).

The Advantages of the Sutures of the *Cranium* are these: 1. That this *Capsula* is more easily formed and extended into a spherical Figure, than if it had been one continued Bone. 2. That the Bones which are at some Distance from each other at Birth, might then yield, and allow to the Head a Change of Shape, accommodated to the Passage it is engaged in. Whence, in hard Labour of Child-bed, the Bones of the *Cranium*, instead of being only brought into Contact, are sometimes made to mount one upon the other. 3. It is alledged, that thro' the Sutures there is a Transpiration of Steams from the Brain, which was the old Doctrine; or some Communication of the Vessels without, and of those within the Skull, larger here than in any other Part of the *Cranium*, according to some Moderns; and therefore *Cucuphæ*, *Fomentations*, *Cataplasms*, *cephalic Plaisters*, *Blisters*.

G. 2.

(a) *Hunault*. *Memoires de l'Acad. des Sciences*, 1730.

(b) *Winslow*. *Memoires de l'Acad. des Sciences*, 1720.

sters are applied, and *Issues* are eroded, or cut in the Head, at those Places where the Sutures are longest in forming, and where the Connexion of the Bones is afterwards loosest, for the Cure of a *Phrenitis*, *Mania*, *inveterate Head-ach*, *Epilepsy*, *Apoplexy*, and other Diseases of the Head. The Favourers of the Doctrine of Transpiration, or Communication of Vessels at the Sutures, endeavour to support it by Facts: For they (a) assert, that Persons were subject to Head-achs which caused Death, from the Sutures being too closely united. 4. That the *Dura Mater* may be more firmly supported by its Processes, which insinuate themselves into this Conjunction of the Bones; for doing this equally, and where the greatest Necessity of Adhesion is, the Sutures are disposed at nearly equal Distances, and the large *Reservoirs* of Blood, the *Sinuses*, are under or near them. 5. That Fractures might be prevented from reaching so far as they would in a continued bony Substance. 6. That the Connexion at the Sutures being capable of yielding, the Bones might be allowed to separate; which has given great Relief to Patients from the violent Symptoms which they had before this Separation happened (b). And it seems reasonable to believe, that the opening of the Sutures was of great Benefit

(a) *Columb. de re Anat. lib. 1. cap. 5.---Verduc. nouvelle Osteologie, chap. 14.---Dionis, Anat. 3. Demostr. des Os.*

(b) *Ephemerid. Germanic. Dec. 1. Ann. 4. & 5. Observ. 33.*

Of the Skeleton.

to several others who were rather judged to have been hurt by it (a): For we must think, that the Consequences of such a Force acting upon the Brain, as was capable of thrusting the Bones a sunder, must have been fatal, unless it had been thus yielded to.

Having gone through the general Structure of the *Cranium*, I now proceed to examine each Bone of which that Brain-case consists, in the Order in which I first named them.

The *OS FRONTIS* * has its Name from its being the only Bone of that Part of the Face we call the *Forehead*, though it reaches a good deal further. It has some Resemblance in Shape to the Shell of the *Concha bivalvis*, commonly called the *Cockle*; for the greatest Part of it is convex externally, and concave internally, with a serrated circular Edge; while the smaller Part has Processes and Depressions, which make it of an irregular Figure.

The external Surface of the *Os frontis* is smooth at its upper convex Part; but several Processes and Cavities are observable below: For, at each Angle of each Orbit, the Bone juts out, to form four Processes, two internal, and as many external; which, from this Situation, may well enough be named

G. 3. angular.

(a) Ephemerid. Germ. Dec. 2. Ann. 9. Obs. 230. Ibid. Cent. 10. Obs. 31. Vander Linden Medicin. Phys. cap. 8. art. 4. § 16. Hildan. Observ. Cent. 1. Obs. 21. Cent. 2. Obs. 79. Pechlin, Observ. Lib. 2. Observ. 39.

* *Meninges, Bonyæ, Coronæ, Inverecundum, Puppis, Scleræ communis, Sincipitis.*

Of the Skeleton.

ular. Between the internal and external angular Processes of each Side, an arch'd Ridge is extended, on which the Eyebrows are placed.—Very little above the internal End of these *superciliary* Ridges; a Protuberance may be remarked in most Skulls, where the Bone is protruded, to make room for two large Cavities; of which hereafter.—Betwixt the internal angular Processes, a small Process rises, which forms some Share of the Nose, and thence is named *Nasal*.—Some observe a protuberant Part on the Edge of the Bone behind each external angular Process, which they call *temporal* Processes; but these are inconsiderable.—From the under Part of the *superciliary* Ridges, the frontal Bone runs a great Way backwards; which Parts may justly enough be called *orbital* Processes. These, contrary to the rest of this Bone, are concave externally, for receiving the Globes of the Eyes, with their Muscles, Fat. &c.

In each of the *orbital* Processes, behind the Middle of the *superciliary* Ridges, a considerable Sinuosity is observed, where the *Glandula innominata Galeni* or *lachrymalis* is lodged. — Behind each internal angular Process, a small Pit may be remarked, where the cartilaginous Pully of the *Musculus obliquus major* of the Eye is fixed. — Betwixt these two *orbital* Processes, there is a large Discontinuation of the Bone, into which the cribriform Part of the *Os ethmoides* is incased. The frontal Bone frequently has little Caverns formed in it here where

where it is joined to the ethmoid Bone.— Behind each external angular Process, the Surface of the frontal Bone is considerably depressed where part of the temporal Muscle is placed.

The *Foramina*, or Holes, observable on the external Surface of the frontal Bone, are three in each Side.—One in each superciliary Ridge, a little removed from its Middle towards the Nose; through which a Twig of the *Ophthalmic* Branch of the fifth Pair of Nerves passes out of the Orbit, with a small Artery from the internal Carotid, to be distributed to the Teguments and Muscles of the Forehead.—These Vessels in some Skulls make Furrows in the *Os frontis*, especially in the Bones of Children, as has also been observed of another considerable Vessel of this Bone near its Middle (a): and therefore we ought to beware of transverse Incisions on either Side of the *Os frontis*, which might open these Vessels, while they are yet in part within the Bone; for, in such a Case, it is difficult to stop an Hemorrhagy, because the Adhesion of a Part of the Artery to the Bone, hinders its Contraction, and consequently Styptics can have little Effect; the Sides of the Furrow keep off compressing Substances from the Artery; and we would wish to shun Cauteries or Escharotics, because they make the Bone carious.—But, to return to the *superciliary Foramina*, we must remark, that often, instead of an Hole, a Notch only is

(a) *Ruyssch*, Mus. Anat. Theca D. Reposit. 4. N^o. 3.

to be seen: Nay, in some Skulls, scarce a Vestige even of this is left; in others, both Hole and Notch are observable, when the Nerve and Artery run separately. Frequently a Hole is found on one Side, and a Notch on the other; at other Times we see two Holes; or there is a common Hole without, and two distinct Entries internally. The Reason of this Variety of a Hole, Notch, Depression, or Smoothness in the superciliary Ridge, is the different Length and Tension of the Nerves and Vessels; the shorter they are, the more they are sunk into the Bone as it grows.—Near the Middle of the Inside of each Orbit, hard by, or in the *transverse Suture*, there is a small Hole left, for the Passage of the nasal Twig of the first Branch of the fifth Pair of Nerves, and of a Branch of the ophthalmic Artery. This Hole is sometimes entirely formed in the *Os frontis*; in other Skulls, the Sides of it are composed of this last Bone, and of the *Os planum*. It is commonly known by the Name of *Orbitarium internum*, though *anteriorius* should be added, because of the next, which is commonly omitted.—This, which may be called *Orbitarium internum posterius*, is such another as the former; only smaller, and about an Inch deeper in the Orbit: Through it a small Branch of the internal *Carotid Artery*, sent off before it pierces the *Dura Mater*, passes to the Nose.—Besides these six, there are a great Number of small Holes observable on the outer Surface of this Bone, particularly in the two Protuberances

berances above the Eye-brows, under which the *Sinuses* are. Most of these penetrate no further than the *Sinuses*, or than the *Diploe*, if the *Sinuses* are wanting; though sometimes I have seen this Bone so perforated by a vast Number of these small Holes, that, placed between the Eye and a clear Light, it appeared like a Sieve. In the Orbit of the Generality of *Skeletons*, we may observe one, two, or more Holes, which allow a Passage to a Hog's Bristle through the Skull. The Place, Magnitude and Number of these, is however uncertain: They generally serve for the Transmission of small Arteries or Nerves.

The internal Surface of the *Os frontis* is concave, except at the orbital Processes, which are convex, to support the anterior Lobes of the Brain. This Surface is not so smooth as the external; for the larger Branches of the Arteries of the *Dura Mater* make some Furrows in its Sides and back Parts.—The Sinuosities from the luxuriant Risings of the Brain, mentioned when describing the general Structure of the *Cranium*, are often very observable on its upper Part; and its lower and fore Parts are marked with the Contorsions of the anterior Lobes of the Brain.—Through the Middle of this internal Surface, where always in Children, and frequently in old People, the Bone is divided, either a Ridge stands out, to which the upper Edge of the *Falx* is fastened, or a Furrow runs, in which the upper Side of the superior longitudinal *Sinus*

is

is lodged; on both these accounts chyrurgical Authors justly discharge the Application of the Trepan here. The Reason of this Difference in Skulls, is alledged by some Authors to be this, That in thin Skulls the Ridge strengthens the Bones, and in thick ones there is no Occasion for it. To this Way of accounting for this Phænomenon, it may justly be objected, that generally very thick Skulls have a large Spine here, and frequently thin ones have only a Furrow. Perhaps this Variety may be owing to the different Times of a compleat Ossification of those Parts in different Subjects: For if the two Sides of this Bone meet before they arrive at their utmost Extent of Growth, they unite very firmly, and all their Fibres endeavour to stretch themselves out where the least Resistance is, that is, between the Hemispheres of the Brain. To support this Reasoning, we may remark, that those Adults, whose frontal Bone is divided by the sagittal Suture, never have a Ridge in this Place.

Immediately at the Root of this Ridge or Furrow there is a small Hole, which sometimes pierces through the first Table, and, in other Skulls, opens into the superior *Sinus* of the *Ethmoid* Bone within the Nose. In it a little Process of the *Falx* is lodged, and a small Artery, and sometimes a Vein, runs (a); and the superior longitudinal *Sinus* begins here.—This Hole, however, is often not entirely proper to the *Os frontis*; for in several

(a) *Morgagn. Adversar. 6. Animad. 31.*

veral Skulls, the lower Part of it is formed in the upper Part of the Base of the *Crista Galli*, which is a Process of the *Os Ethmoides* (a).

The *Os frontis* is composed of two Tables, and an intermediate *Diploe*, as the other Bones of the *Cranium* are, and, in a middle Degree of Thickness between the *Os occipitis* and *parietalia*, is pretty equally dense all through, except at the orbital Processes; where, by the Action of the Eye on one Side, and Pressure of the Lobes of the Brain on the other, it is made extremely thin and diaphanous, and the *Meditullium* is entirely obliterated. Since in this Place there is so weak a Defence for the Brain, the Reason appears why Fencers esteem a Push in the Eye so mortal (b).

The *Diploe* is also exhausted in that Part above the Eye-brows, where the two Tables of the Bone separate, by the external being protruded outwards, to form two large Cavities, called *Sinus frontales*.—These are divided by a middle perpendicular bony Partition.—Their Capacities in the same Subject are seldom equal; in some the Right, in others the Left is largest.—And in different Bones their Size is as inconstant; nay, I have examined some, where they were entirely wanting; which oftener happens in such as have a flat Fore-head, and whose sagittal Suture is continued

(a) *Ingrass.* Comment. in *Galen.* de Ossib. cap. 1. Comment. 8.

(b) *Ruyfch.* Observ. Anat. Chir. Observ. 54.—*Diemerbroeck.* Anat. lib. 3. cap. 10.

continued down to the Nose, than in others (a): And in Children, they are never seen. — In some Skulls, besides the large perpendicular *Septum*, there are several bony Pillars, or short Partitions, found in each *Sinus*; in others these are wanting. — For the most part the *Septum* is entire; at other Times it is discontinued, and the two *Sinuses* communicate. — When the *Sinuses* are seen in such Skulls as have the frontal Bone divided by the sagittal Suture, the Partition dividing these Cavities, is evidently composed of two Plates, which easily separate. — Each *Sinus* commonly opens by a roundish small Hole, at the inner and lower Part of the internal angular Processes, into a *Sinus* formed in the Nose, at the upper and back Part of the *Os unguis*; near to which there are also some other small *Sinuses* of this Bone (b), the greater Part of which open separately nearer the *Septum narium*, and often they terminate in the same common Channel with the large ones.

In a natural and sound State, these Cavities are of considerable Advantage; for the Organ of Smelling being thus enlarged, the *Effluvia* of odorous Bodies more difficultly escape it; and their Impressions being more numerous, are therefore stronger, and affect the Organ more. — These and the other Cavities which open into the Nose, increase the

(a) Fallop. Exposit. de Ossibus. cap. 13.

(b) Cowper in Drake's Anthropolog. Book 3. Chap. 10.

the Sound of our Voice, and render it more melodious, by serving as so many Vaults to resound the Notes. Hence People labouring under a *Coryza*, or Stoppage of the Nose from any other Cause, when they are by the Vulgar, though falsely, said to speak through their Nose, have such a disagreeable harsh Voice.—The Liquor separated in the Membrane of these Sinuses, drills down upon the Membrane of the Nose to keep it moist.

From the Description of these *Sinuses*, it is evident, how useless, nay how pernicious it must be, to apply a Trepan on this Part of the Scull; for this Instrument, instead of piercing into the Cavity of the *Cranium*, would reach no further than the *Sinuses*; or, if the inner Table was perforated, any extravasated Blood that happened to be within the Scull, would not be discharged outwardly, but would fall into the *Sinuses*, there to stagnate, corrupt, and stimulate the sensible Membranes; from which also there would be such a constant Flow of glairy Mucus, as would retard, if not hinder a Cure, and would make the Sore degenerate into an incurable *Fistula*. Besides, as it would be almost impossible in this Case to prevent the Air, passing through the Nose, from having constant Access to the *Dura Mater*, or Brain; such a Corruption would be brought on these Parts, as would be attended with great Danger. Further, In Respiration, the Air rushing violently into these Cavities of the *Os frontis*,

tis, and passing through the external Orifice, whenever it was not well covered, and defended, would not only prevent the closing up of the external Orifice, but might otherwise bring on bad Consequences (a).

—The Membrane lining these *Sinuses* is so sensible, that Inflammations of it, must create violent Torture; and Worms, or other Insects, crawling there, must give great Uneasiness (b.)

The upper circular Part of the *Os frontis*, is joined to the *Offa parietalia*, from one Temple to the other, by the coronal Suture. From the Termination of the coronal Suture to the external angular Processes, this Bone is connected to the *Sphenoid* by the *sphenoidal* Suture. At the external *Canthi* of the Eyes, its angular Processes are joined by the transverse Suture to the *Offa malarum*, to which it adheres one third down the Outside of the Orbits; whence to the Bottom of these Cavities, and a little up on their internal Sides, these orbital Processes are connected to the *sphenoidal* Bone by that same Suture.—In some few Skulls, however, a Discontinuation of these two Bones appears at the upper Part of the long Slit, near the Bottom of the Orbit.—On the Inside of each Orbit, the orbital Process is indented between the *cribriform* Part of

(a) *Paaw*, de Ossibus Pars. 1. cap. 7. — *Palfyne* Anatom. chir. Traite 4. chap. 15. Nouvelle Osteologie, Partie 2. chap. 3.

(b) *Bartholin*. Epistol. Medic. Cent. 2. Epist. 74. — Hist. de l'Acad. des Sciences, 1708 & 1733.

of the *ethmoid* Bone, and the *Os planum* and *unguis*.—The transverse Suture afterwards joins the frontal Bone to the superior nasal Processes of the *Ossa maxillaria superiora*, and to the *Ossa nasi*. And, lastly, its nasal Process is connected to the nasal *Lamella* of the *ethmoid* Bone.

The *frontal* Bone serves to defend and support the anterior Lobes of the Brain. It forms a considerable Part of the Cavities that contain the Globes of the Eyes, helps to make up the *Septum narium*, Organ of Smelling, &c. From the Description of the several Parts, the other Uses of this Bone are evident.

In a ripe Child, the frontal Bone is divided through the Middle; the superciliary Holes are not formed; often a small round Piece of each orbital Process, behind the superciliary Ridge, is not ossified, and there is no *Sinus* to be seen within its Substance.

Each of the two *OSSA PARIETALIA*, or Bones serving as Walls to the *Encephalon*, is an irregular Square; its upper and fore Sides being longer than the one behind or below. The inferior Side is a concave Arch; the middle Part receiving the upper round Part of the temporal Bone.—The Angle formed by this upper Side, and the fore one, is so extended, as to have the Appearance of a Process.

H 2

The

* *Kopups*, *Paria*, *syncephitis*, *verticis*, *arcualia*, *nervalia*, *cogitationis*, *rationis*, *bregmatitis*, *madefactionis*.

The external Surface of each *Os parietale* is convex. Upon it, somewhat below the middle Height of the Bone, there is a transverse arched Ridge, of a whiter Colour generally than any other Part of the Bone; from which, in Bones that have strong Prints of Muscles, we see a great many converging Furrows, like so many *Radii* drawn from a Circumference towards a Center. From this Ridge of each Bone the temporal Muscle rises; and, by the Pressure of its Fibres, occasions the Furrows just now mentioned.—Below these, we observe, near the semicircular Edges, a great many Risings and Depressions, which are joined to like Inequalities on the Inside of the temporal Bone, to form the squamous Suture. The temporal Bone may therefore serve here as a Buttress, to prevent the lower Side of the Parietal from starting outwards when its upper Part is pressed or struck (*a*).

Near the upper Sides of these Bones, towards the hind Part, is a small Hole in each, through which a Vein passes from the Teguments of the Head to the longitudinal *Sinus*. Sometimes I have seen a Branch of the temporal Artery pass through this Hole, to be distributed to the upper Part of the *Falx*, and to the *Dura Mater* at its Sides, where it had frequent Anastomoses, with the Branches of the Arteries derived from the external Carotids, which commonly have the Name of the Arteries of the *Dura Mater*,

(*a*) *Hunauld* in *Mem. de l'Acad. des Sciences*, 1730.

ter, and with the Branches of the internal Carotids which serve the *Falx*.—In several Skulls, one of the *Ossa parietalia* has not this Hole; in others, there are two in one Bone; and in some not one in either. Most frequently this Hole is thro' both Tables; at other Times, the external Table is only perforated.—The Knowledge of the Course of these Vessels, may be of Use to Surgeons, when they make any Incision near this Part of the Head; lest, if the Vessels are rashly cut near the Hole, they shrink within the Substance of the Bone, and so cause an obstinate Hæmorrhagy, which neither Ligatures nor Medicines can stop.

On the inner concave Surface of the parietal Bones, we see a great many deep Furrows, disposed somewhat like the Branches of Trees: The Furrows are largest and deepest at the lower Edge of each *Ossa parietalis*, especially near its anterior Angle, where sometimes a full Canal is formed: They afterwards divide into small Furrows, in their Progress upwards.—In some Skulls a large Furrow begins at the Hole near the upper Edge, and divides into Branches; which join with those which come upwards, shewing the Communications of the upper and lower Arteries of the *Dura Mater*.—

In these Furrows we frequently see Passages into the *Diploe*; and sometimes I have observed Canals going off, which allowed a small Probe to pass some Inches into the bony Substance. Some (a) tell us, that they

H 3

(a) Cowper, Anatom. Explic. of XC. Tab. Fig. 2.

they have observed these Canals piercing the Bone towards the *Occiput*.—On the Inside of the upper Edge of the *Ossa parietalia*, there is a large Sinuosity, frequently larger in the Bone of one Side than of the other, where the upper Part of the *Falx* is fastened, and the superior longitudinal *Sinus* is lodged.—Generally Part of the lateral *Sinuses* makes a Depression near the Angle, formed by the lower and posterior Sides of these Bones; and the Pits made by the prominent Parts of the Brain are to be seen in no Part of the Scull more frequent, or more considerable, than in their internal Surface.

The *Ossa parietalia* are amongst the thinnest Bones of the *Cranium*; but enjoy the general Structure of two Tables and *Diploe* the completest, and are the most equal and smooth.

These Bones are joined at their Fore-side to the *Os frontis* by the coronal Suture; at their long inferior Angles, to the *sphenoid* Bone, by Part of the Suture of this Name; at their lower Edge, to the *Ossa temporum*, by the squamous Suture and its posterior *Additamentum*; behind, to the *Os occipitis*, or *Ossa triquetra*, by the lambdoid Suture; and above, to one another, by the sagittal Suture.

They have no particular Uses besides those mentioned in the Description of their several Parts, except what are included in the Account of the general Structure of the *Cranium*.

In a Child born at the full Time, none of the Sides of this Bone are completed; and there never is a Hole near to the sagittal Suture.

The large unossified ligamentous Part of the *Cranium* observable between the parietal Bones, and the Middle of the divided *Os frontis* of new-born Children, called by the Vulgar the *Open of the Head*, was imagined by the Antients to serve for the Evacuation of the superfluous Moisture of the Brain; and therefore they named it *Bregma* *, or the Fountain; sometimes adding the Epithet *pulsatilis*, or beating, on account of the Pulsation of the Brain, felt through this flexible Ligamento-cartilaginous Substance. Hence very frequently the parietal Bones are called *Ossa Bregmatis*.

The *Bregma* is the first Part of a Child that comes out of the *Os uteri* in a natural Birth. If it is stretched, and the Pulsation of the Brain is felt through it, the Child is certainly alive: But if the *Bregma* is shrivelled and flaccid, without any observable Pulsation in it, there is Reason to judge the Child to be very weak, or dead. Those who practise Midwifery should therefore examine the State of the *Bregma* accurately.

All the *Bregma* is generally ossified before seven Years of Age. Several Authors (a) say, they have observed it unossified in Adults;

* *Palpitans vertex, foliolum, folium, triangularis lacuna.*

(a) *Bartholin. Anat. Reform. lib. 4. cap. 6.-----Diemerbroeck, Anat. lib. 9. cap. 6.----Kerkring. Osteogen. cap. 2.*

Adults; and Physicians, who order the Application of Medicines at the Meeting of the coronal and sagittal Sutures, seem yet to think that a Derivation of noxious Humours from the *Encephalon* is more easily procured at this Part than any other of the Skull; and that Medicines have a greater Effect here, than elsewhere, in the internal Disorders of the Head.

OSSA TEMPORUM *, so named, say Authors, from the Hair's first becoming gray on the Temples, and thus discovering Peoples Ages, are each of them equal and smooth above, with a very thin semicircular Edge; which, from the Manner of its Connection with the neighbouring Bones, is distinguished by the Name of *Oss. squamosum*.—Behind this, the upper Part of the temporal Bone is thicker, and more unequal, and is sometimes described as a distinct Part, under the Name of *Part. mammillaris* (a).—Towards the Base of the Skull, the temporal Bone appears very irregular and unequal, and this Part, instead of being broad, and placed perpendicularly, as the others are, is contracted into an oblong very hard Substance, extended horizontally forwards and inwards; which in its Progress becomes smaller, and is commonly called *Oss. petrosum*.

Three

* Κρόταφῶν, κορῶν, κορῶν, λεπιδωδῆ, πολυειδῆ, λιθωδῆ, temporalia, lapidosa, r endosa, dura, arcualia, tympanum, amalia, saxea, perictalia.

(a) *Albin. de Ossib. § 26.*

Three external Processes of each temporal Bone are generally described.—The first placed at the lower and hind Part of the Bone, from its Resemblance to a Nipple, is called *Mastoides*, or *Mammillaris*. It is not solid, but within is composed of *Cancelli*, or small Cells, which have a Communication with the large Cavity of the Ear, the Drum; and therefore Sounds, being multiplied in this vaulted Labyrinth, are increased, before they are applied to the immediate Organ of Hearing. Into the mastoid Process, the *Sternomastoideus* Muscle is inserted; and to its back Part, where the Surface is rough, the *Trachelomastoideus*, and part of the *Splenius* are fixed.—About an Inch farther forward, the second Process begins to rise out from the Bone; and having its Origin continued obliquely downwards and forwards for some Way, it becomes smaller, and is stretched forwards to join with the *Os malæ*; they together forming the bony *Jugum*, under which the temporal Muscle passes. Hence this Process has been named *Zygomatic* *. Its upper Edge has the strong Aponeurosis of the *temporal* Muscle fixed into it; and its lower Part gives rise to a Share of the *Masseter*.—The Fore-part of the Base of this Process is an oblong Tubercle, which in a recent Subject is covered with a smooth polished Cartilage, continued from that which lines the Cavity immediately behind this Tubercle

* Καρχήδς, Paris, anfr ossium temporum, ossa arcualia, paria, jugalia, conjugalia.

bercle.—From the under craggy Part of the *Os temporum*, the third Process stands out obliquely forwards. The Shape of it is generally said to resemble the ancient *Stylus scriptorius*; and therefore it is called the *Styloid Process* †. Some Authors (a) however contend, that it ought to be named *Steloid*, from its being more like to a Pillar. Several Muscles have their Origin from this Process, and borrow one half of their name from it; as *Stylo-glossus*, *Stylo-hyoideus*, *Stylo-pharyngeus*; and to it a Ligament of the *Os hyoides* is fixed. This Process is often even in Adults not entirely ossified, but is ligamentous at its Root, and sometimes is composed of two or three distinct Pieces.—Round the Root of it, especially at the Fore-part, there is a remarkable Rising of the *Os petrosum*, which some have esteemed a Process; and, from the Appearance it makes with the *Styliform*, have named it *Vaginalis*.—Others again have, under the name of *Auditory Process*, reckoned among the external Processes that semicircular Ridge, which, running between the Root of the *mastoid* and *zygomatic* Processes, forms the Under-part of the *Mecatus auditorius externus*. The Sinuosities, or Depressions on the external Surface of each *Os temporum* are

† Γραφοειδῆ, βελονοειδῆ, πλῆκτρον, *Os calaminum*, sagittale, clavale, acuale, calcar capitis.

(a) Galen. de usu Part. lib. xi. cap. 4. Fallop. Observ. Anatom.

these:—A long *Fossa* at the inner and back Part of the Root of the mammary Process, where the posterior Head of the *digestric* Muscle has its Origin. — Immediately before the Root of the *zygomatic* Process, a considerable Hollow is left, for lodging the *crotaphite* Muscle. — Between the *zygomatic*, *auditory* and *vaginal* Processes, a large Cavity is formed; through the Middle of which, from Top to Bottom, a Fissure is observable, into which Part of the Ligament that secures the Articulation of the lower Jaw with this Bone is fixed. The Fore-part of the Cavity being lined with the same Cartilage which covers the Tubercle before it, receives the *Condyle* of the Jaw; and in the Back-part a small Share of the *parotid* Gland, and a cellular fatty Substance are lodged. — At the Inside of the Root of the *styloid* *Apophyse*, there is a Thimble-like Cavity, where the Beginning of the internal jugular Vein, or End of the lateral *Sinus* is lodged. — And as the Sinuses of the two Sides are frequently of unequal Size; so one of these Cavities is as often larger than the other (a). — Round the *Meatus auditorius externus*, several Sinuosities are formed for receiving the Cartilages and Ligaments of the Ear, and for their firm Adhesion.

The

(b) *Hunauld*. in *Mem. de l'Acad. des Sciences*, 1730.

The *Holes* that commonly appear on the Outside of each of these Bones, and are proper to each of them, are five.—The *first*, situated between the *zygomatic* and *mastoid* Processes, is the Orifice of a large Funnel-like Canal, which leads to the Organ of Hearing; therefore is called *Meatus auditorius externus* *.—The *second*, the *Aquæduct* of *Fallopian*, or Passage for the *Portia dura* of the auditory Nerve, is between the *mastoid* and *styloid* Processes.—Some way before, and to the Inside of the *Apophysis styloides*, is the *third Foramen*, the Canal from which runs first upwards, then forwards, and receives into it the internal *carotid* Artery, and the Beginning of the intercostal Nerve; where this Canal is about to make the Turn forwards, one or sometimes two very small Holes go off towards the *Tympanum*; through these *Valsalva* (a) affirms the proper Artery or Arteries of the *Tympanum* are sent.—On the anterior Edge of this Bone, near the former Hole, a *fourth* Hole is observable, being the Orifice of a Canal, which runs outwards and backwards, in an horizontal Direction, till it terminates in the Cavity of the Ear called *Tympanum*. This, in the recent Subject, is continued forward and inward, from the Parts which I mentioned just now as its Orifice in the Skeleton, to the Side of the Nostrils; being partly cartilaginous, and partly

* Πόρος της ακοῆς, ὅπῃ τῶν ὠτῶν. Fenestra aurium.

(a) De Aure humana, cap. 2. § 22. et Tab. 7. Fig. I.

partly ligamentous. The whole Canal is named, *Iter à palato ad aurem*, or *Tuba Eustachiana*.—On the external Side of the bony Part of this Canal, and a-top of the Chink in the Cavity that receives the *Condyle* of the lower Jaw, is the Course of the little Nerve said commonly to be reflected from the lingual Branch of the fifth Pair, till it enters the *Tympanum*, to run across this Cavity, and to have the Name of *Chorda Tympani*.—The *fifth* Hole is very uncertain, appearing sometimes behind the *mastoid* Process; sometimes it is common to the temporal and occipital Bones; and in several Skulls there is no such Hole. The Use of it, when found, is for the Transmission of a Vein from the external Teguments to the lateral *Sinus*: But, in some Subjects, a Branch of the occipital Artery passes through this Hole, to serve the back Part of the *Dura Mater*; in others, I have seen two or three such Holes: But they are oftener wanting than found. And we may, once for all, in general remark, That the Largeness, Number, Situation and Existence of all such Holes, that for the most part allow only a Passage for Veins from without to the internal Receptacles, are very uncertain.

The internal Surface of the *Ossa temporum* is unequal; the upper circular Edge of the squamous Part having numerous small Ridges and Furrows for its Conjunction with the parietal Bones; and the rest of it is irregularly marked with the Convolution

of the middle Part of the Brain, and with Furrows made by the Branches of the Arteries of the *Dura Mater*.

From the under Part of this internal Surface, a large transverse hard craggy Protuberance runs horizontally inwards and forwards, with a sharp Edge above, and two flat Sides, one facing obliquely forwards and outwards, and the other as much backwards and inwards. To the Ridge between these two Sides, the large lateral Process of the *Dura Mater* is fixed.

Sometimes a small Bone, a-kin to the Sesamoid, is found between the small End of this *petrous* Process and the *sphenoid* Bone (a).

Towards the back Part of the Inside of the *Os temporum*, a large deep *Fossa* is conspicuous, where the *lateral Sinus* lies; and frequently on the Top of the *petrous* Ridge, a Furrow may be observed, where a small *Sinus* is situated.

The internal proper *Foramina* of each of these Bones are, *first*, the *Meatus auditorius internus* in the posterior plain Side of the *Processus petrosus*. This Hole soon divides into two; one of which is the Beginning of the *Aquæduct* of *Fallopian*; the other ends in three or four (*Valsalva* (b) says six) Canals, that allow a Passage to the Branches of the *Portio mollis* of the seventh Pair

(a) *Riolan*, Comment. de Ossib. cap. 32.-----*Winslow*, Exposition Anatomique de corps humain, Traité des Os Secs, § 266.

(b) *De aure humana*, cap. 3. § 11.

Pair of Nerves, into the *Vestibulum* and *Cochlea*. Through it also an Artery is sent, to be distributed to the Organ of Hearing. —The *second* Hole, which is on the anterior plain Side of the craggy Process, gives Passage to a Branch of the lateral Artery of the *Dura Mater*, which joins the *Portia dura* of the auditory Nerve, while it is in the *Aquæduct* (a). Frequently, however, a Branch of the *Portio dura*, accompanied with a Branch of that Artery which went into the *Meatus auditorius* along with the acoustick Nerve, enters into the *Cranium* here, to be distributed to the soft Parts, at the Side of the *Sella Turcica* (b). —Near to this second Hole, there are often several small ones, where Arteries or Twigs of Nerves enter. On the posterior Surface, near the auditory *Foramen*, other small Holes may be taken notice of: They seem only to convey Vessels to the Substance of the Bone. —The Passage of the cutaneous Vein into the lateral *Sinus*, or of a Branch of the occipital Artery, is seen about the Middle of the large *Fossa* for that *Sinus*; and the Orifice of the Canal of the *carotid* Artery, is evident at the under Part of the Point of the *petrous* Process.

Besides these proper Holes of the temporal Bones which appear on their external and internal Surfaces, there are two others in each Side that are common to this Bone, and to the *Os occipitis* and *sphenoides*; which

I 2

shall

(a) *Fallop.* Observ. Anatom.(b) *Valsalv.* De aure, cap. 3, § 10.

shall be mentioned afterwards in the Description of these Bones.

The upper round Part of the squamous Bones is thin, but equal; while the low petrous Part is thick and strong, but irregular and unequal, having the Distinction of Tables and *Diploe* confounded, with several Cavities, Processes, and Bones within its Substance, which are Parts of the Organ of Hearing. That a clear Idea may be had of this beautiful, but intricate Organ, Anatomists generally chuse to demonstrate all its Parts together. I think the Method good; and therefore, since it would be improper to insert a compleat Treatise on the Ear here, shall omit the Description of the Parts contained within the *Os petrosum* of the Skeleton.

The temporal Bones are joined above to the parietal Bones by the squamous Sutures, and their posterior *Additamenta*: Before, to the *sphenoid* Bone by the Suture of that Name; to the *Ossa malarum* by the zygomatic Sutures: Behind, to the *occipital* Bone by the *Lambdoid* Suture and its *Additamenta*; and they are articulated with the *lower Jaw*, in the Manner which shall be described when this Bone is examined.

The Purposes which these two Bones serve, are easily collected, from the general Use of the *Cranium*, and from what has been said in the Description of their several Parts.

In an Infant, a small Fissure is to be observed between the thin upper Part and the
lower

lower craggy Part of each of these Bones; which points out the recent Union of these Parts. — Neither *mastoid* nor *styloid* Processes are yet to be seen. — Instead of a bony Funnel-like *Meatus auditorius externus*, there is only a smooth bony Ring, within which the *Membrana Tympani* is fastened. — At the Entry of the *Tuba Eustachiana*, the Side of the *Tympanum* is not completed. — A little more outward than the internal auditory Canal, there is a deep Pit, over the upper Part of whose Orifice the interior semicircular Canal of the Ear is stretched; and some way below this, the posterior semicircular Canal also appears manifestly.

OS OCCIPITIS *, so called from its Situation, is convex on the Outside, and concave internally. Its Figure is an irregular Square, or rather *Rhomboid*; of which the Angle above is generally a little rounded; the two lateral Angles are more finished, but obtuse; and the lower one is stretched forward in Form of a Wedge, and thence is called by some the *cuneiform* Process. — If one would, however, be very nice in observing the several Turns which the Edges of the *Os occipitis* make, five or seven Sides, and as many Angles of this Bone, might be described.

The external Surface is convex, except at the cuneiform Apophyse, where it is flattened. At the Base of this triangular Process,

* Ἰπὸν, Basilare, Proræ, Memoria, Pixidis, Fibrosum, Nervosum, Lambde.

cesses, on each Side of the great Hole, but more advanced forwards than the Middle of it, the large oblong Protuberances, named the *Condyles*, appear, to serve for the Articulation of this Bone with the first *Vertebra* of the Neck. The smooth Surface of each of these *Condylloid* Processes is longest from behind forwards, where, by their oblique Situation, they come much nearer to each other than they are at their back Part. Their inner Sides are lower than the external, by which they are prevented from sliding to either Side out of the Cavities of the first *Vertebra* (a). In some Subjects each of these plain smooth Surfaces seems to be divided by a small Rising in its Middle; and the lower Edge of each Condyle, next the great *Foramen*, is discontinued about the Middle, by an interveening Notch; whence some (b) alledge, that each of these *Apophyses* is made up of two Protuberances.—Round their Root a small Depression and spongy Roughness is observable, where the Ligaments for surrounding and securing the Articulations adhere.—Though the Motion of the Head is performed on the Condyles, yet the Center of Gravity of that Globe does not fall between them, but is a good Way further forward; from which Mechanism it is evident, that the Muscles which pull the Head back, must be in a constant State of Contraction; which is stronger than the natural Contraction of the pro-
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(a) *Galen. de usu Part. lib. 12. cap. 7.*

(b) *Diemerbroeck, Anat. lib. 9. cap. 6.*

per Flexors, else the Head would always fall forwards, as it does when a Man is asleep, or labours under a Palsy, as well as in Infants, where the Weight of the Head far exceeds the proportional Strength of these Muscles. This seeming disadvantageous Situation of the Condyles is however of good Use to us, by allowing sufficient Space for the Cavities of the Mouth and Fauces, and for lodging a sufficient Number of Muscles, which commonly serve for other Uses; but may at Pleasure be directed to act on the Head, and then have an advantageous Lever to act with, so as to be able to sustain a considerable Weight appended, or other Force applied, to pull the Head back.

Somewhat more externally than the *Condyles*, there is a small Rising and semilunar Hollow in each Side, which make up Part of the *Foramina* common to the occipital Bone, and to the *Ossa petrosa*. Immediately behind this, on each Side, a scabrous Ridge is extended from the Middle of the Condyle, towards the Roots of the *Mastoid Process*. Into this Ridge the *Musculus lateralis*, commonly ascribed to *Fallopian*, is inserted.—About the Middle of the external convex Surface, a large Arch runs across the Bone; from the upper lateral Parts of which the *Musculi occipitales* have their Rise; to its Middle the *Trapezii* are attached; and half Way between this and the great *Foramen*, a lesser Arch is extended.—In the Hollows between the
Middle

Middle of these Arches, the *Complexi* are inserted; and in the Depressions more external and further forward than these, the *Splenii* are inserted. — Between the Middle of the lesser Arch and the great Hole, the little hollow Marks of the *recti minores* appear; and on each Side of these the fleshy Insertions of the *abliqui superiores* and *recti majores* make Depressions. — Through the Middle of the two Arches a small sharp *Spine* is placed, which serves as some sort of Partition between the Muscles of different Sides, or rather is owing to the Action of the Muscles depressing the Bone on each Side of it, while this Part is free from their Compression. — These Prints of the Muscles on this Bone are very strong and plain in some Subjects, but are not so distinct in others. — All round the great *Foramen* the Edges are unequal, for the firmer Adhesion of the strong circular Ligament which goes thence to the first *Vertebra*. — One End of each *lateral* or *moderator* Ligament of the Head, is fixed to a rough Surface at the Fore-part of each Condyle, and the *perpendicular* one is connected to a rough Part of the Edge of the great Hole between the two Condyles. — Immediately before the Condyles, two little Depressions are made in the external Surface of the cuneiform Process, for the Insertion of the *Musculi recti anteriores minores*, which are unjustly ascribed to *Cowper*: And still further forward, nearer the *sphenoid* Bone, are two other such Depressions,

ons, for the Reception of the *recti anteriores majores*.—When we consider the Size of the Prints of Muscles on the occipital Bone, before and behind its Condyles, and, at the same time, compare their Distances from these Centers of Motion of the Head, we must see how much stronger the Muscles are which pull the Head backwards, than those are which bend it forward; and how much greater Force the former acquire by the long Lever they act with, than the latter which are inserted so near the Condyles. This great Force in the extensor Muscles is altogether necessary, that they might not only keep the Head from falling forward in an erect Posture, but that they might support it when we bow forward in the most necessary Offices of social Life, when the Weight of the Head comes to act at right Angles on the *Vertebræ* of the Neck, and obtains a long Lever to act with.

On the inner Surface of the *Os occipitis* we see two Ridges; one standing perpendicular, the other running horizontally across the first. The upper Part of the perpendicular Limb of the Cross, to which the *Falx* is fixed, is hollowed in the Middle, or often in one Side, for the Reception of the *superior longitudinal Sinus*, and the lower Part of it has the small or third Process of the *Dura Mater* fastened to it, and is sometimes hollowed by the *occipital Sinus*. Each Side of the horizontal Limb is made hollow by the lateral Sinuses inclosed in the transverse

transverse Process of the *Dura Mater*; the *Fossa* in the right Side being generally a Continuation of the one made by the longitudinal Sinus in the perpendicular Limb, and therefore is larger than the left one (a). —Round the Middle of the Cross there are four large Depressions separated by its Limbs; the two upper ones being formed by the back Part of the Brain, and the two lower ones by the *Cerebellum*. —Farther forward than the last mentioned Depressions, is the lower Part of the *Fossa* for the lateral Sinus on each Side. —The inner Surface of the cuneiform Apophyse is made concave for the Reception of the *Medulla oblongata*, and a Furrow is made on each Side, near the Edges of this Process, by a Sinus of the *Dura Mater*, which empties itself into the lateral Sinus (b.)

The Holes of this Bone are commonly five proper, and two common to it and to the *Ossa temporum*. —The first of the proper Holes, called *Foramen magnum* * from its Size, is immediately behind the Wedge-like Process, and allows a Passage to the *Medulla oblongata*, *Nervi accessorii*, to the vertebral Arteries, and sometimes to the vertebral Veins. —At each Side of this great Hole, near its Fore-part, and immediately above the Condyles, we always find a Hole, sometimes two, which soon unite again into one that opens externally; thro' these

(a) Morgagn. Advers. Anat. 6. Animad. 1.

(b) Allin. de Ossib. § 65.

* Rachitidis, Medullæ spinalis.

these the ninth Pair of Nerves go out of the Scull.—The fourth and fifth Holes pierce from behind the *Condyle* of each Side into the *Fossæ* of the lateral *Sinuses*; they serve for the Passage of the cervical Veins to these *Sinuses*. Often one of these Holes is wanting, sometimes both, when the Veins pass thro' the great *Foramen*.—Besides these five, we frequently meet with other Holes near the Edges of this Bone, for the Trans-mission of Veins; but their Number and Diameter are very uncertain.—The two common *Foramina* are the large irregular Holes, one in each Side, between the Sides of the *Processus cuneiformis*, and the Edges of the *Ossa petrosa*. In a recent Subject, a strong Membrane runs cross from one Side to the other of each of these Holes; and in some Heads I have seen this Membrane ossified, or a bony Partition dividing each Hole; and, in the greater Number of adult Sculls, there is a small sharp-pointed Process stands out from the *Os petrosum*, and a more obtuse Rising in the occipital Bone, between which the Partition is stretched. Behind this *Septum*, where the largest Space is left, the *lateral Sinus* has its Passage; and before it the eight Pair of Nerves and *Accessorius* make their Exit out of the Scull; and some Authors say, an Artery passes through this Hole, to be bestowed on the *Dura Mater*.

The *Os occipitis* is among the thickest Bones of the *Cranium*, though unequally so; for it is stronger above, where it has no other Defence than the common Teg-ments,

ments, than it is below, where, being protected by the Lobes of the Brain and *Cerebellum* on one Side, and by the Action of the Muscles on the other, it is so very thin, as to be diaphanous in many Skulls: But then these Muscles ward off any Injury; and the Ridges and Spines, which are frequent here, make it sufficiently strong to resist ordinary Forces. The Tables and *Diploe* are tolerably distinct in this Bone, except where it is so thin as to become diaphanous.

The occipital Bone is joined above to the *Ossa parietalia* and *Triquetra* when present, by the *Lambdoid Suture*;—laterally to the *Ossa temporum*, by the *Additamenta* of the *Lambdoid Suture*;—below to the *sphenoid Bone*, by the End of its cuneiform Process, in the same Way that Epiphyses and their Bones are joined: For, in Children, a ligamentous Cartilage is interposed between the occipital and sphenoid Bones, which gradually turns thinner, as each of the Bones advances, till their Fibres at last run into each other; and, about sixteen or eighteen Years of Age, the Union of these two Bones becomes so intimate that a Separation cannot be made without Violence.—The *Os occipitis* is articulated below with the first *Vertebrae* of the Neck, by what I have described as the third or long *Species* of *Ginglimus*; for each Condyle is received into a superior oblique Process of that *Vertebrae*. What Motion is allowed here, we shall consider afterwards, where the *Vertebrae* are described.

The

The Uses of this Bone appear from the preceeding Description, and therefore need not be repeated.

An Infant born at the full Time, has this Bone divided, by unossified Cartilages, into four Parts.—The first of these is larger than the other three, is of a triangular Shape, and constitutes all the Part of the Bone above the great *Foramen*. Generally Fissures appear in the upper Part and Sides of this triangular Bone, when all the Cartilage is separated by Maceration; and sometimes little distinct Bones are seen towards the Edges of it.—The second and third Pieces of this Bone are exactly alike, and situated on each Side of the great *Foramen*; from which very near the whole Condyles are produced; and they are extended forwards almost to the Fore-part of the Hole for the ninth Pair of Nerves.—The fourth Piece is the cuneiform Process, which forms a small Share of the great *Foramen*, of the Holes for the ninth Pair of Nerves, and of the Condyles: Betwixt it and the *sphenoid* Bone, a Cartilage is interposed.

Of the eight Bones which belong to the *Cranium*, there are only two which are not yet described, viz. the *Ethmoid* and *Sphenoid*. These we already mentioned, in Complaisance to the Generality of Writers on this Subject, as Bones common to the *Cranium* and Face, because they enter in to the Composition of both: But the same Reason might equally be used for calling the frontal Bone a common one too. I shall,

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however,

however, pass any idle Dispute about the Propriety of ranging them, and proceed to examine the Structure of the Bones themselves.

OS ETHMOIDES *, or the Sieve-like Bone, has got its Name from the great Number of small Holes with which that Part of it first taken notice of is pierced. When this Bone is entire, the Figure of it is not easily described; but, by a Detail of its several Parts, some Idea may be afforded of the whole; and therefore I shall distinguish it into the *Cribriform Lamella* with its Process, the *Nasal Lamella*, *Cellulæ*, and *Ossa spongiosa*.

The thin horizontal *Lamella*, is all (except its Back-part) pierced obliquely by a great Number of small Holes, through which the Filaments of the olfactory Nerves pass. In a recent Subject, these *Foramina* are so closely lined by the *Dura Mater*, that they are much less conspicuous than in the *Skeleton*.—From the Middle of the internal Side of this Plate, a thick Process rises upwards, and, being highest at the Fore-part, gradually becomes lower, as it is extended backwards. From some Resemblance which this Process was imagined to have to a Cock's Comb, it has been called *Crista galli* †. The *Falx* is connected to its Ridge, and to the unperforated Part of the cribriform Plate.—When the *Crista* is broke, its Base is sometimes

* Cribriforme, *σπογγειδής*, Spongiforme.

† *Verruca prædura*, septum ossis spongiosi.

times found to be hollow, with its Cavity opening into the Nose (a).—Immediately before the highest Part of this Process, is the blind Hole of the *Os frontis*, which, as was formerly remarked, is often in a good measure formed by a Notch in the Fore-part of the Root of the *Crista*.

From the Middle of the outer Surface of the *Cribriform Lamella*, a thin solid perpendicular Plate stands out, which has the same common Base with the *Crista galli*. Generally it is not perpendicular, but is inclined to one Side or other, and therefore divides the Cavity of the Nose unequally.—It is thin at its Rise, and rather still thinner in its Middle; yet afterwards, towards its lower Edge, it becomes thicker, that its Conjunction with the Bones and middle Cartilage of the Nose might be firmer.

At a little Distance from each Side of this external Process, a cellular and spongy bony Substance is conspicuous. The Number and Figure of the Cells in this irregular Process of each Side, are very uncertain, and not to be represented in Words; only the Cells open into each other, and into the Cavity of the Nose: The uppermost, which are below the Aperture of the frontal *Sinuses*, are formed like a Funnel.—The outer Surface of these Cells is smooth and plain, where this Bone assists in composing the Orbit; at which Place, on each Side, it has got the Name of *Os planum*; on the upper Edge of which, a small Notch or two may some-

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times.

(a) *Palfyn. Anat. Chir. Tr. 4. Chap. 15.*

times be observed, which go to the Formation of the *Foramina orbitaria interna*; as was remarked in the Description of the *Os frontis*.

Below the Cells of each Side, a thin Plate is extended inwards, and then bending down, it becomes thick and of a spongy Texture.—This spongy Part is triangular, with a streight upper Edge placed horizontally, an anterior one slanting from above, downwards and forwards, and with a pendulous convex one below.—The upper and lower Edges terminate in a sharp Point behind.—The Side of this pendulous spongy Part next to the *Septum Narium* is convex, and its external Side is concave.—These two Processes of the *ethmoid* Bone have got the Name of *Offa spongiosa*, or *Turbinata superiora*, from their Substance, Figure, and Situation.

All the Prominencies, Cavities and *Meanders* of this *ethmoid* Bone, are covered with a Continuation of the Membrane of the Nostrils, in a recent Subject.—The horizontal cribriform *Lamella* of this Bone, is lodged between the orbitar Processes of the *frontal* Bone, to which it is joined by the *ethmoid* Suture, except at the Back-part, where it is connected with the *Cuneiform* Bone, by a Suture common to both the Bones, though it is generally esteemed part of the *sphenoidal* Suture.—Where the *Offa plana* are contiguous to the *frontal* Bone within the Orbit, their Conjunction is reckoned Part of the transverse Suture.

—Farther

—Farther forward than the *Ossa plana*, the Cells are covered by the *Ossa unguis*, which are not only contiguous to these Cells, but cannot be separated from them, without breaking the bony Substance; and therefore, in Justice, those Bones ought to be demonstrated as part of the *ethmoid* Bone.

—Below the *Ossa unguis* and *plana*, these Cells and *Ossa spongiosa* are overlapped by the *Ossa maxillaria*.—The cellular Part of the *Ossa palati* is contiguous to the *Ossa plana* and Cells backwards.—The lower Edge of the Nasal perpendicular *Lamella* is received into a Furrow of the *Vomer* by *Schindylesis*.—Its posterior Edge is joined to the Fore-part of the *Processus azygos* of the *sphenoid* Bone.—Its upper Edge joins the Nasal Process of the *Os frontis* and *Ossa nasi*, and its anterior one is connected to the middle Cartilage of the Nose.

From all which, the Uses of this Bone are evident, *viz.* to sustain the anterior Lobes of the Brain; to give Passage to the olfactory Nerves, and Attachment to the *Falx*; to enlarge the Organ of Smelling, by allowing the Membrane of the Nose a great Extent; to straiten the Passage of the Air through the Nose, by leaving only a narrow winding Canal, on the sensible membranous Sides of which the Substances conveyed along with the Air must strike; to form part of the Orbit of the Eyes and *Septum narium*; while all its Parts are so light, as not to be in hazard of separating by their Weight; and they are so

thin, as to form a large Surface, without occupying much Space. This brittle Substance, however, is sufficiently protected from external Injuries by the firm Bones which cover it.

If this Bone is seized on by any corroding Matter, we may easily conceive what Destruction may ensue. Hence it is, that an *Ozæna* is difficult to cure; and that, in violent *Scurvies*, or in the *Lues Veneræ*, the Fabrick of the Nose, the Eyes, and Life itself are in danger.—The Situation of the Nasal *Lamella* may shew us, how dangerous a Fracture of the Bones of the Nose may be, when made by a Force applied to their middle Fore-part.

The *Ethmoid* Bone of ripe Children is divided into two, by a perpendicular Cartilage, which, when ossified, is the *Crista galli*, and Nasal *Lamella*: But its other Parts are ossified and compleat.

OS SPHENOIDES *, or Wedge-like Bone, so called because of its Situation in the Middle of the Bones of the *Cranium* and Face, is of such an irregular Figure, that I know not any thing to which it may be likened, unless, perhaps, it bear some faint Resemblance to a Bat with its Wings extended.

When we view the Outside of the *Os sphenoides*, five remarkable Processes may be observed, which are all of them again subdivided.—The first and second are the

two

* Cuneiforme, *πυξίμορφον*, multiforme, paxillum, cribratura, palati, colatorii, cavilla, basillare

two large lateral *Apophyses* or Wings; the upper Part of each of which is called the *temporal Process*, because they join with the temporal Bones in forming the Temples, and the Seat for some Share of the *crota-phite* Muscles. That Part of the Wings which juts out towards the Inside, somewhat lower than the temporal *Apophyses*, and is smooth and hollowed; where it makes up Part of the Orbit, is thence named *orbital Processes*. Behind the Edge, separating these two Processes, there is often a small Groove, made by a Branch of the superior maxillary Nerve, in its Passage to the temporal Muscle. The lowest and back Part of each Wing, which runs out sharp to meet the *Ossa petrosa*, has been styled *Apophysis spinosa*: From near the Point of which a sharp-pointed Process is frequently produced downwards, which some call *Styloid*, that affords Origin to the *Ptery-staphylinus externus* Muscle. From this styloid Process a very small Groove is extended along the Edge of the Bone to the Hollow at the Root of the internal Plate of the following Processes, which forms Part of the *Eustachian Tube* (a).—The third and fourth external Processes of the *cuneiform* Bone, are the two which stand out almost perpendicular to the Base of the Skull. Each of them has two Plates, and a middle *Fossa* facing backwards, and should, to carry on our Comparison, be likened to the Bat's Legs,

(a) Winslow, Exposition Anatomique du corps humain, Traité des Os secs, § 233.

Legs, but are commonly said to resemble the Wings of that Creature; and therefore are named *Pterygoid* or *Aliform* * Processes. The external Plates are broadest, and the internal are longest. From each Side of the external Plates the *pterygoid* Muscles take their Rise. At the Root of each internal Plate, a small Hollow may be remarked, where the *Musculus ptery-staphylinus internus*, or *circumflexus palati* rises, and some Share of the cartilaginous End of the *Eustachian* Tube rests; and, at the lower End of the same Plate, is a Hook-like Rising or Process, round which the Tendon of the last named Muscle plays, as on a Pulley. From the Edge of the external Plates some small sharp Spikes stand out; but their Number and Bulk are uncertain.—The fifth external Process of the *sphenoid* Bone is that sharp middle Ridge which stands out from the Base of this Bone: Because it wants a Fellow, it may be called *Processus azygos*. The lower Part of this Process, where it is received into the *Vomer*, is thick, and often not quite perpendicular, but inclining more to one Side than the other. The Fore-part of this Process, where it joins the Nasal *Lamella* of the *Os Ethmoides*, is thin and streight. These two Parts have been described as two distinct Processes by some.

The Depressions, Sinuosities, and *Fossie*, on the external Surface of this *sphenoid* Bone, may be reckoned up to a great Number,

* Naviculares.

Number, viz. two on the temporal *Apophyses*, where the *crotaphite* Muscles lodge.—Two on the *orbital* Processes, to make way for the Globes of the Eyes.—Two between the *temporal* and *spinous Apophyses*, for receiving the temporal Bones. — Two between the Plates of the *pterygoid* Processes, where the *Musculi pterygoidei interni* and *Ptery-staphylini interni* are placed.—Two between the *pterygoid* and *orbital* Processes, for forming the Holes common to this Bone, and to the *Ossa malarum* and *maxillaria*.—Two on the lower Ends of the *aliform* Processes, which the *Ossa palati* enter into.—Two at the Roots of the *temporal* and *pterygoid* Processes, where the largest Share of the external *pterygoid* Muscles have their Rise.—Two at the Sides of the *Processus azygos*, for forming Part of the Nose, &c.

What I described under the Name of *temporal* and *spinous Processes* on the Outside of the Skull, are likewise seen on its Inside, where they are concave, for receiving Part of the Brain; and commonly three *Apophyses* on the internal Surface of the *sphenoid* Bone are only mentioned.—Two rising broad from the Fore-part of its Body, become smaller as they are extended obliquely backwards.—The third standing on a long transverse Base, near the Back-part of the Body of this Bone, rises nearly erect, and of an equal Breadth, terminating often in a little Knob on each Side. The three are called *Clinoid*, from some Resemblance

blance which they were thought to have to the Supporters of a Bed. Sometimes one or both the anterior *clinoid* Processes are joined to the Sides of the posterior one, or to the Body of the Bone itself.—From the Roots of the anterior *clinoid* Processes the Bone is extended on each Side outwards and forwards, till it ends in a sharp Point, which may have the Name of the *Transverse spinous* Processes. — Between, but a little farther back than the two anterior *clinoid* Processes, we see a Protuberance considerably smaller than the posterior *clinoid* Process, but of its Shape. — Another Process often forces itself forwards into the *Os Ethmoides*, from between the transverse Processes.

Within the Skull, there are two Sinuities in the internal Part of each Wing of the *sphenoid* Bone, for receiving the middle Part of the Brain.—One between the transverse spinous Processes, for lodging the *Crura medullæ oblongatæ*.—Immediately before the third or middle *clinoid* Process, a single Pit generally may be remarked, from which a *Fossa* goes out on each Side to the *Foramina optica* of this Bone. The Pit is formed by the conjoined optick Nerves; and in the *Fossæ* these Nerves are lodged, as they run divided within the Skull.—Between that third Protuberance and the posterior *clinoid* Process, the large Pit for the *Glandula pituitaria* may be remarked. This Cavity, because of its Resemblance to a *Turkish Saddle*, is always described

described under the Name of *Sella Turcica*, or *Ephippium*.—On the Sides of the posterior *clinoid* Process a *Fossa* may be remarked, that stretches upwards, then is continued forwards along the Sides of the *Sella Turcica*, near to the anterior *clinoid* Processes, where a Pit on each Side is made. These *Fossæ* point out the Course of the two internal *carotid* Arteries after they have entered the Scull.—Besides all these, several other *Fossæ* may be observed, leading to the several *Foramina*, and imprinted by the Nerves and Blood-vessels.

The *Foramina* on each Side of the *Os sphenoides* are six proper, and three common.—The *first* is the round Hole immediately below the anterior *clinoid* Processes, for the Passage of the optick Nerve, and of the Branch of the internal *carotid* Artery that is sent to the Eye.—The *second* is the *Foramen lacerum*, or large Slit between the transverse spinous and orbitar Processes: The interior End of which Slit is large; and, as it is extended outwards, it becomes narrower. The outer End of it is formed in the *Os frontis*; and therefore this might be reckoned among the common *Foramina*. Through it the *Nervi motores oculi*, *Pathetici*, and first Branch of the fifth, the whole sixth Pair of Nerves, except one reflected Branch, according to the most common Descriptions of the Nerves, and an Artery from the internal Carotid, go into the Orbit. Sometimes a small Branch of the external Carotid enters near its End, to be distributed

distributed to the *Dura Mater* (a), and a Vein, some call it *Ductus Venosus* or *Nack's Aquæduct*, returns through it to the petrosal Sinus.—The *third* Hole, situated a little behind the one just now described, is called *Rotundum*, from its Shape. It allows Passage to the second Branch of the fifth Pair of Nerves, or superior maxillary Nerve, into the Bottom of the Orbit.—The *fourth* is the *Foramen ovale*, about half an Inch behind the round Hole. Through it the third Branch of the fifth Pair of Nerves, or *maxillaris inferior*, goes out; and sometimes a Vein from the *Dura Mater* passes out here (b).—Very near the Point of the spinous Process is the *fifth* Hole of this Bone: It is small and round, for a Passage to the largest Artery of the *Dura Mater*, which often is accompanied with a Vein.—The *sixth* proper Hole (c) cannot be well seen, till the cuneiform Bone is separated from all the other Bones of the *Cranium*; for one End of it is hid by a small Protuberance of the internal Plate of the *pterygoid* Process, and by the Point of the *Processus petrosus* of the *Os temporum*. Its Canal is extended above the inner Plate of the *pterygoid* Process; and where it opens into the Cavity of the Nose, it is concealed by

(a) *Winslow*, Exposition Anatomique de corps humain, Traité des Arteres, § 60. & de la Tete, § 26.

(b) *Ingrassi*. Commentar. in *Galen*. de Offib. lib. 1. comment. 8.

(c) *Vesal*. Anat. lib. 1. cap. 12.—*Eustach*. Tab. 46. Fig. 13. & 16.-----*Vidus Vidius*, Anat. lib. 2. cap. 2. Explicat. Tab. 5. & Tab. 5. Fig. 8. 9. 10. lit. O.

Branch of that Artery which enters the sixth *Foramen pterygoideum* is sent through this Substance to the *Dura Mater*. It was by this Passage that the Ancients believed the *Pituita* was conveyed from the Emunctory of the Brain, the *Glandula pituitaria*, to the *Fauces*.—The *second* common Hole is the large Discontinuation of the external Side of the Orbit, left between the orbital Processes of the cuneiform Bone, the *Os maxillare, malæ*, and *palati*. In this large Hole the Fat for lubricating the Globe of the Eye and temporal Muscle is lodged, and Branches of the superior maxillary Nerve, with small Arteries from the Carotid and Veins pass.—The *third* Hole is formed between the Base of this Bone and the Root of the orbital Process of the Palate-bone of each Side. Through this a Branch of the external carotid Artery, and of the second Branch of the fifth Pair of Nerves, are allowed a Passage to the Nostrils, and a returning Vein accompanies them. Sometimes, however, this Hole is proper to the Palate-bone, being entirely formed out of its Substance.

Under the *Sella Turcica*, and some way farther forward, but within the Substance of the *sphenoid* Bone, are two *Sinuses*, separated by a bony Plate. Each of them is lined with a Membrane, and opens into the upper and Back part of each Nostril by a round Hole, which is at their upper Forepart. This Hole is not formed only by the *Os sphenoides*, which has an Aperture

near

near as large as any transverse Section of the *Sinus*, but also by the *Ossa palati*, which are applied to the Fore-part of these *Sinuses*, and close them up, that Hole only excepted, which was already mentioned. Frequently the two *Sinuses* are of unequal Dimensions, and sometimes there is only one large Cavity, with an Opening into one Nostril. These Cavities are likewise said (a) to be extended sometimes as far back as the great *Foramen* of the occipital Bone. In other Subjects they are not to be found, when the Bone is composed of large Cells (b). Some (c) mention a Cavity within the Partition of the *Sinuses*; but it is small.—The *sphenoidal Sinuses* serve the same Uses as the frontal do.

As this Bone is extremely ragged and unequal, so its Substance is of very different Thickness, being in some Places diaphanous; in others it is of a middle Thickness, and its middle Back-part surpasses the greatest Share of the *Cranium* in Thickness.

The *Os sphenoides* is joined, by its Wings, to the *Ossa parietalia* above, to the *Os frontis* and *Ossa malarum* before, to the *Ossa temporum* behind; —by the Fore-part of its Body and spinous Processes, to the *Os frontis* and *Ethmoides*; —by its Back-part, behind the two *Sinuses*, to the *Os occipitis*, where it looks like a Bone with the *Epiphyses* taken off, and, as was formerly observed

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(a) *Albin. de Ossib. § 39.*(b) *Vesal. lib. 1. cap. 6.*(c) *Id. ibid.*

in the Description of the occipital Bone, it is not to be separated without Violence in Adults; —to the *Ossa palati*, by the Ends of the *pterygoid* Processes, and still more by the Fore-part of the internal Plates of the *pterygoid* Processes, and of the *Sinuses*; —to the *Ossa maxillaria*, by the Fore-part of the external *pterygoid* Plates; —to the *Vomer* and *Nasal Lamella* of the *Os Ethmoides*, by the *Processus azygos*. All these Conjunctions, except the last, which is a *Schindylesis*, are said to be by the Suture proper to this Bone; though it is at first Sight evident, that several other Sutures, as the *transverse*, *ethmoidal*, &c. are confounded with it.

We see now how this Bone is joined to all the Bones of the *Cranium*, and to most of the Upper Jaw; and therefore obtained the Name of the *Wedge-like Bone*.

The Uses are so blended with the Description, as to leave nothing new to be added concerning them.

The *sphenoid* Bone is almost compleat in a *Fœtus* of nine Months; only the great *Alæ* separate after Maceration from the Body of the Bone. —The *Processus azygos* is very large and hollow; —the internal Surface of the Body is unequal and porous; —the *Sinuses* do not appear.

Whoever is acquainted with each Bone of the *Cranium*, can, without Difficulty, examine them as they stand united, so as to know the Shapes, Sizes, Distances, &c. of their several Parts, and the Forms, Capacities, &c. of the Cavities formed by them, which is
of

of great Use towards understanding the Anatomy of the Parts contiguous to, contained within, or connected to them. Such a Review is necessary, after considering each Class of Bones. Thus the Orbits, Nostrils, Mouth, Face, Head, Spine, *Thorax*, *Pelvis*, Trunk, Extremities, and Skeleton, ought likewise to be examined.

The *FACE* is the irregular Pile of Bones, composing the fore and under Part of the Head, which is divided, by Authors, into the Upper and Lower *Maxillæ* or Jaws.

The *superior Maxilla* † is the common Designation given to the upper immoveable Share of the Face; though, if we would follow *Celsus* (*a*), we should apply the Word *Maxilla* to the Lower Jaw only, and use the Name *Mala* for this Upper Jaw. In Compliance to prevailing Custom, I shall, however, follow the Terms now commonly employed—The Shape of the superior *Maxilla* cannot easily be expressed; nor is it necessary, provided the Shape and Situation of all the Bones which compose it are described. It is bounded above by the transverse Suture, behind by the Fore-part of the *sphenoid* Bone, and below by the Mouth.

The upper Jaw consists of six Bones on each Side, of a thirteenth Bone which has no Fellow, placed in the Middle, and of sixteen Teeth. The thirteen Bones are, two *Ossa nasi*, two *Ossa unguis*, two *Ossa malarum*, two *Ossa maxillaria*, two *Ossa palati*,

L 3

two

† Σταχυν, γένος, Mandibula.

(a) Lib. 8. cap. 1.

two *Ossa spongiosa inferiora*, and the *Vomer*.

The *Ossa nasi* are placed at the upper Part of the Nose; — the *Ossa unguis* are at the internal *Canthi* of the Orbits; — *Ossa malarum* form the Prominence of the Cheeks; — *Ossa maxillaria* form the Side of the Nose, with the whole Lower and Fore-part of the Upper Jaw, and the greatest Share of the Roof of the Mouth; — *Ossa palati* are situated at the Back-part of the Palate, Nostrils, and Orbit; — *Ossa spongiosa* are seen in the lower Part of the *Nares*; — and the *Vomer* helps to separate these two Cavities.

The Bones of the *Upper Jaw* are joined to the Bones of the Scull by the *Schindylesis* and Sutures already described as common to the *Cranium* and *Face*, and they are connected to each other by *Gomphosis* and fifteen Sutures.

The *Gomphosis* only is where the Teeth are fixed in their Sockets.

The Sutures are generally distinguished by Numbers, which have been differently applied; and therefore I join those (a) who prefer the giving Names to each, which may be easily contrived from their Situation, or from the Bones which they connect.

The first is the *anterior Nasal* †, which is streight, and placed longitudinally in the middle Fore-part of the Nose.

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(a) *Vander Linder*, Medicin. physiolog. cap. 13. art. 2. § 10. — *Rolfinc*. Anat. lib. 2. cap. 25. — *Schenk*. Schol. part. § ult. par. 2. cap. 5.

† *Nasalis Recta*.

The second and third are the *lateral Nasal**, which are at each Side of the Nose, and almost parallel to the first Suture.

Each of the two *Lacrymal* is almost semicircular, and is placed round the *lacrymal Groove*.

The sixth and seventh are the *internal Orbital*; each of which is extended obliquely from the Middle of the lower Side of an Orbit to the Edge of its Base.

The two *external Orbital* are continued, each from the End of the internal Orbital, to the Under and Fore part of the Cheek.

The tenth is the *maxillary*, which reaches only from the lower Part of the *Septum narium* to between the two middle *Dentes Incisores*.

The *longitudinal Palate* † Suture stretches from the Middle of the foremost Teeth through the Middle of all the Palate.

The *transverse Palate* one ‡ runs across the Palate, nearer the Back than the Fore part of it.

Each of the two *Palato-maxillary* is at the Back-part of the Side of each Nostril.

The fifteenth is the *Spinous*, which is in the Middle of the lower Part of the Nostrils. This may, perhaps, be rather thought a double *Schindylesis*.

The Connexion of the *Ossa spongiosa* to the Side of each Nostril, is so much by a Membrane in young Subjects, and by Connexion or Union of Substance in Adults,
that

* *Nasalis Obliqua*.

† *Laquearis, Palataria recta*,

‡ *Arcuata, Palatina postica*.

that I did not know well how to rank it: But if any chuses to call it a Suture, the Addition of two *transverse Nasal* Sutures may be made to those above named.

These Sutures of the Face (formerly called *Harmoniæ*) have not such conspicuous Indentations as those of the Scull have; the Bones here not having Substance enough for forming large Indentations, and there being less Necessity for Security against external Injuries, or any internal protruding Force, than in the *Cranium*.—These Sutures often disappear in old People, by the Bones running into each other; which can do little Prejudice, because the principal Use of the Bones being so numerous here, is to allow them to be extended into a proper Form.

It is evident, from the Manner of the Conjunction of these Bones, that they can have no Motion, except in common with the *Cranium*.

The Purposes which this Pile of Bones serves, will be shewn in the Description which I am to give of each.

OSSA NASI, so named from their Situation at the Root of the Nose, are each of an irregular oblong square Figure, being broadest at their lower End, narrowest a little higher than their Middle, and becoming somewhat larger at the Top, where they are ragged and thickest, and have a Curvature forwards, that their Connexion with the *Oss frontis* might be stronger. — These Bones are convex externally, and thereby better resist any Violence from without; and they

they are concave internally, for enlarging the Cavity of the Nose.

The lower Edge of these Bones is unequal, and is stretched outwards and backwards, to join the Cartilages of the Nostrils.—Their anterior Side is thick, especially above, and unequal, that their Conjunction to each other might be stronger; and a small Rising may be remarked on their inner Edge, where they are sustained by the *Septum narium*.—Their posterior Side, at its upper Half, has externally a Depression, where it is overlapped some way by the *Ossa maxillaria*, while its lower Half covers these Bones: By which Contrivance, they do not yield easily to Pressure applied to their Fore-part or Sides.

A small Hole is frequently to be observed on their external Surface, into which two, three, or four Holes, which appear internally, terminate, for the Transmission of small Veins.

The *Nasal Bones* are firm and solid, with very few *Cellulæ* or *Cancelli* in them; the thin Substance, of which they consist, not requiring much Marrow.

They are joined above to the *Os frontis*, by the Middle of the transverse Suture;—behind, to the *Ossa maxillaria*, by the *lateral Nasal Sutures*;—below, to the Cartilages of the Nose;—before, to one another, by the *anterior Nasal Suture*;—internally, to the *Septum narium*.

These Bones serve to cover and defend the Root of the Nose.

In an Infant the *Nasal Bones* are proportionally shorter, and less thick at their upper Part, than in an Adult, but are otherwise compleat.

OSSA UNGUIS, or *LACRYMALIA*, are so named, because their Figure and Magnitude is something near that of a Nail of one's Finger, and because the Tears pass upon them into the Nose.

Their external Surface is composed of two smooth Concavities and a middle Ridge. — The Depression behind forms a small Share of the Orbit for the Eye-ball to move on, and the one before is a deep perpendicular Canal, or *Fossa*, larger above than below, containing the lacrymal *Sac* and *Duct*. — This *Fossa* of the Bone is cribriform, or has a great Number of small Holes through it, that the Filaments from the Membrane which lines it, insinuating themselves into these Holes, might prevent a Separation of the Membrane, and secure the Bone in its natural Situation. — The Ridge between these two Cavities of the *Os unguis*, is the proper Boundary of the Orbit at its internal *Canthus*. — The internal or posterior Surface of this Bone consists of a Furrow in the Middle of two Convexities.

The Substance of the *Os unguis* is as thin as Paper, and very brittle; which is the Reason that those Bones are often wanting in Skeletons.

Each of these Bones is joined, above, to the *Os frontis*, by Part of the *transverse* Suture;

ture;—behind, to the *Os planum* of the *Ethmoid* Bone, by the same Suture;—before, and below, to the *Os maxillare*, by the *lacrymal* Suture.—Internally, the *Ossa unguis* cover some of the *Sinus ethmoidales*; nay, are really continuous with the bony *Lamellæ*, which make up the Sides of these Cells; so that they are as much Part of the *Ethmoid* Bone, as the *Ossa plana*.

These unguiform Bones compose the anterior internal Parts of the Orbits, lodge the lacrymal Sac and Duct, and cover the *Cellulæ ethmoidæ*.—Their Situation and tender Substance, make a rash Operator in danger of destroying a considerable Share of the Organ of Smelling, when he is performing the Operation of the *Fistula lacrymalis*; but when these Bones are hurt, they cast off without much Difficulty, and consequently the Wound is soon cured, unless the Patient labours under a general *Cacoethes*, or there is a Predisposition in the Bones to *Caries*; in which Case, a large Train of bad Symptoms follows, or, at best, the Cure proves tedious.

These Bones are fully formed in a new born Child.

OSSA MALARUM * was the Name given by *Celsus*, as was already remarked, to all the Upper Jaw; but is now appropriated to the prominent square Bones, which form the Cheek on each Side.—Before, their Surface is convex and smooth; backward,

* Jugalia vel Zygomatica, hypopia, subocularia.

ward, it is unequal and concave, for lodging Part of the *Crotaphyte* Muscles.

The four Angles of each of these Bones have been reckoned Processes by some.—The one at the external *Canthus* of the Orbit, called the *superior orbital* Process, is the longest and thickest.—The second terminates near the Middle of the lower Edge of the Orbit in a sharp Point, and is named the *inferior orbital* Process.—The third, placed near the lower Part of the Cheek, and thence called *maxillary*, is the shortest, and nearest to a right Angle.—The fourth, which is called *Zygomatic*, because it is extended backwards to the *Zygoma* of the temporal Bone, ends in a Point, and has one Side streight, and the other sloping.—Between the two orbital Angles there is a concave Arch, which makes about a Third of the external Circumference of the Orbit, from which a fifth Process is extended backwards within the Orbit, to form near one Third of that Cavity; and hence it may be called the *internal orbital* Process.—About the Middle of this, we may remark a considerable Notch, which forms part of the great Slit at the Outside of the Orbit.—From the lower Edge of each of the *Ossa malarum*, which is between the maxillary and zygomatic Processes, the *Masseter* Muscle takes its Origin; and from the exterior Part of the *Zygomatic* Process the *Musculus distortor oris* rises; in both which Places the Surface of the Bone is rough.

On

On the external Surface of each Cheek-bone, one or more small Holes are commonly found, for the Transmission of small Nerves or Blood-vessels from, and sometimes into the Orbit.—On the internal Surface are the Holes for the Passage of the nutritious Vessels of these Bones.—A Notch on the Outside of the *internal orbital* Process of each of these Bones, assists to form the great Slit common to this Bone, and to the Sphenoid, Maxillary, and Palate Bones.

The Substance of these Bones is in Proportion to their Bulk; thick, hard, and solid, with some *Cancelli*.

Each of the *Ossa malarum* is joined, by its superior and internal orbital Processes, to the *Os frontis*, and to the orbital Process of the *sphenoid* Bone, by the transverse Suture.—By the Edge between the internal and inferior orbital Processes to the *Os maxillare*, by the *internal orbital* Suture.—By the Side between the maxillary and inferior orbital Process, again to the maxillary Bone, by the *external orbital* Suture.—By the zygomatic Process to the *Os temporum*, by the *zygomatic* Suture.

The Cheek-bones are entire, and fully ossified in all their Parts in Infants.

OSSA MAXILLARIA SUPERIORA, are the largest Bones, and constitute the far greater Part of the Upper Jaw, which has appropriated the Name of *Maxillaria* to them. The Figure of one of them, or of the two when joined, is so irregular, that Words can scarce give an Idea of it.

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The *Apophyses* of each *Os maxillare* may be reckoned seven.—The *first* is the long *Nasal Process* at its upper and fore Part, which is broad below, and turns smaller, as it rises upwards, to make the Side of the Nose.—At the Root of this, a transverse Ridge may be observed within the Nostrils, which supports the Fore-part of the upper Edge of the *Os spongiosum inferius*.——The *second* is produced backwards and outwards, from the Root of the Nasal Process, to form the lower Side of the Orbit; and therefore may be called *orbital*.——The Edge of this orbital Process, and the Ridge of the nasal one, which is continued from it, make a considerable Portion of the external Circumference of the Orbit.—From the proper orbital Process, a very rough triangular Surface is extended downwards and outwards, to be connected to the Cheek-bone; and therefore may be called the *malar Process*, from the lowest protuberant Part of which some Share of the masseter Muscle takes its Rise.—Behind the orbital Process, a large Tuberosity, or Bulge of the Bone appears, which is esteemed the *fourth* Process.—On the internal Part of this we often meet with a Ridge, almost of the same Height with that in the Nasal Process, which runs transversely, and is covered by a similar Ridge of the *Os palati*, on which the back Part of the upper Edge of the *Os spongiosum inferius* rests.—The convex back Part of this Tuberosity is rough, for the Origin of Part of the external *pterygoid* Muscle

Muscle (a), and more internally is scabrous, where the Palate and sphenoid Bones are joined to it.—That spongy Protuberance * at the lower Circumference of this Bone, where the Sockets for the Teeth are formed, is reckoned the *fifth*. — The *sixth* is the horizontal Plate, which forms the greater Part of the Base of the Nostrils, and Roof of the Mouth: Its upper Surface, which belongs to the Nostrils, is very smooth, but the other below is arched and rough, for the stronger Adhesion of the Membrane of the Mouth, which is stretched upon it, and, in chewing, speaking, &c. is liable to be separated.—The *seventh* rises like a Spine from the inner Edge of the last, and forms a small Part of the *Septum narium*.

The Depressions in each *Os maxillare* are, 1. A Sinuosity behind the orbital Process, made by the *temporal* Muscle. 2. A Pit immediately before the same Process, where the Origin of the *Musculus elevator labiorum communis*, and *Elevator labii superioris*, with a Branch of the fifth Pair of Nerves, are lodged securely. 3. The hollow Arch of the Palate. 4. The semicircular great Notch, or Entry to the lower Part of the Nostrils, betwixt the Root of the Nasal Process and Spine of the palatine *Lamella*.—Below this, the Fore-part of the Bone is flatted, or sometimes hollowed by the *Musculus depressor labii superioris*. 5. Sockets for the Teeth†:

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The

(a) *Albin*, de Ossib. § 79.

* *ἀντία*.

† *Βόδρια, ὀλμίσχοι*, Alveoli, Fossulae, mortariola, Fræna, Locelli, Cavæ, Præsepiola, Loculamenta.

The Number of these Sockets is uncertain; for the same Number of Teeth is not in all People, and the four backmost Teeth of each Jaw vary greatly in their Number of Roots; and when the Teeth of a living Person fall out, or are taken away, the Sockets fill up with an osseous Net-work, which becomes solid afterwards.—6. The *lacrymal Fossa* in the *Nasal Process*, which assists the *Os unguis* to form a Passage for the *lacrymal Duct*.—Immediately on the Outside of this, there is a small Depression, from which the inferior or lesser oblique Muscle of the Eye has its Origin (a). 7. The Channel on the upper Part of the great Tuberosity within the Orbit, which is almost a compleat Hole; in this a Branch of the superior maxillary Nerve passes.—Besides these, the superior Surface of the great Bulge is concave, to receive the under Part of the Eye.—Immediately above the transverse Ridge in the *Nasal Process*, a small Hollow is formed by the *Os spongiosum*.—In some Subjects, the *Nasal Process* has a small round Pit above the *lacrymal Duct*, where the little Tendon or Ligament of the orbicular Muscle of the Eyelids is inserted. It is this Tendon, and not the Tendon of the larger oblique Muscle of the Eye, which there is a Probability of cutting in the Operation of the *Fistula lacrymalis*.

The *Foramina* of this Bone are two proper, and two common, which are always
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(a) Winslow, Exposition Anatomique des Os Sees, § 276.

to be found, besides several others, whose Magnitude, Number, &c. are uncertain.—The first of the proper is the *external Orbital*, immediately below the Orbit, by which the *infra-orbital Branch* of the second Branch of the fifth Pair of Nerves, and a small Artery, come out, after having passed in the Channel, at the Bottom of the Orbit, described *Numb. 7.* of the Depressions.—This Hole is often double, and that when the Nerve has happened to split before it has escaped from the Bone.—The second is the *Foramen incisivum*, just behind the Fore-teeth, which, at its under Part, is one irregular Hole common to the *Ossa maxillaria*, when they are joined; but, as it ascends, soon divides into two, three, or sometimes more Holes; some of which open into each Nostril. Through them small Arteries and Veins, and a Twig of the second Branch of the fifth Pair of Nerves pass, and make a Communication between, or join the lining Coats of the Nose and Mouth.—In some Subjects, *Steno's* Duct may be traced some way on the Side of these Passages next to the Nose, and small Orifices may be observed opening into the Mouth.

The first common Hole is that which appears at the inner Side of the Back-part of the *Tuberosity* and of the *Alveoli* of the Teeth, and is formed by a *Fossa* in this Bone, and a corresponding one in the *Os palati*: Through it a Nerve, which is a Branch of the second Branch of the fifth Pair of

Nerves, runs to the Palate.—The other common Hole is the great Slit in the Outside of the Orbit described already, as the second common Hole of the sphenoid Bone.

On the Nasal Process often Holes may be observed for the Passage of Vessels to the Substance of the Bones; and, at the Back-part of each Tuberosity, several *Foramina* are placed, for the Transmission of Nerves to the Cavity within: But these are uncertain.

All the Body of the *Os maxillare* is hollow, and leaves a large *Sinus*, a-kin to those of the *Os frontis* and *sphenoides*, which is commonly, but unjustly, called *Antrum Highmorianum* *. When the *Os maxillare* is single or separated from all the other Bones of a Skeleton, its *Antrum* appears to have a large Aperture into the Nostrils; but, in a recent Subject, it is so covered at its Back-part, by the *Os palati*; in the Middle, by the *Os spongiosum inferius*; before, by a strong Membrane, that one, or sometimes two *Foramina*, scarce larger than a Crow-quill, are only left at the upper Part; which, after a short winding Progress, open into the *Nares*, between the two *Ossa spongiosa*.—At the Bottom of this Cavity, we may often observe some Protuberances, in which the small Points of the Roots of the Teeth are contained (a).—This Cavern, and the Sockets of the Teeth are often divided by the Interposition

* Genæ.

(a) Highmore, Disquis. Anat. lib. 3. part 2. cap. 1.

Interposition only of a very thin bony Plate, which is liable to be eroded by acrid Matter collected in the *Antrum*, or to be broke in drawing a Tooth (a). The Symptoms of a Collection of Matter naturally lead us to the Practice of pulling out the Teeth, and piercing through this Plate into the *Antrum*; to procure an Evacuation of the collected Matter; by which considerable Service is frequently done (b).

The *maxillary Sinuses* have the same Uses as the *frontal* and *sphenoidal*; and the Situation of the *Sinuses* is such, that the Liquor drilling from them, from the Cells of the Ethmoid and Palate Bones, and from the lacrymal Ducts, may always moisten all the Parts of the Membrane of the *Nares* in the different Situations which the Head is in.

Though the Membranes, which line the *frontal*, *sphenoidal*, and *maxillary Sinuses*, are Continuations of the one which covers the Bones of the *Nares*; yet they are much thinner than it is, and have so much smaller Vessels, that the Injection which makes the Membrane of the Nose red all over, fills only some few Vessels of the *maxillary Sinuses*, and scarce is observed in the *frontal* and *sphenoidal*. Are not the larger Vessels intended for a more plentiful Secretion of a viscid Liquor to defend the Membrane from the Effects of the *Perflatus*, which is constantly through the Nose? Are not the Membranes,

(a) Highmore, Disquis. Anat. lib. 3. part. 2. cap. 1.

(b) Cowper in Drake's Anthropol. Book 3. chap. 10. Medical Essays and Observ. Vol. V. Art. 30.

branes which have the smallest Vessels, *cæteris paribus*, the most sensible? Are not many Phænomena of Smelling, Inflammations of these Parts, *Megrim*, *Polypi*, &c. depending on this Structure of these Membranes?

The Substance of the *Ossa maxillaria* is compact and firm, except at the inferior Process, in which the Teeth are lodged, where it is very spongy.

The *maxillary* Bones are joined above by the upper Ends of their nasal Processes to the *Os frontis*, by the transverse Suture; — at the Sides of these Processes, to the *Ossa unguis*, by the *lacrymal* Sutures; — to the *Ossa nasi*, by the *lateral Nasal* Sutures; — by their orbital Processes, to the *Ossa malarum*, by the *external orbital* Sutures; — by the internal Sides of the internal orbital Processes, to the *Ossa plana*, by part of the *ethmoidal* Suture; — by the Back-part of the Tuberosities, to the *Ossa palati*, by the *Suturæ palato-maxillares*; — by the posterior Edges of their palatine *Lamellæ*, to the *Ossa palati*, by the *transverse* Palate Suture; — by their Nasal *Spines*, to the *Vomer*, by the *spinous* Suture; — by their Sockets, to the Teeth, by *Gomphosis*; — by the internal Edge of the Palate *Lamella*, to one another, by the *longitudinal* Palate Suture; on the Upper and Fore part of which a Furrow is left for receiving the Cartilage which forms the Partition of the Nostrils; — between the Fore-part of the Nostrils and Mouth, to each other by the *mystachial* Suture; — sometimes they are connected

to

to the *Ossa spongiosa inferiora*, by a plain Concretion or Union of Substance.

These Bones form the greater Part of the Nose and of the Roof of the Mouth, and a considerable Share of the Orbit. They contain sixteen Teeth, give Rise to Muscles, Transmission to Nerves, &c. as mentioned in the Description of their several Parts.

In each of the *Ossa maxillaria* of a new-born Child, the external orbital Process is hollow with remarkable *Foramina* in it; — there are only five Sockets for the Teeth, of which the two posterior are very large. — The Palate *Lamella* is cribriform about the Middle. — The great Tuberosity is not formed; — instead of the *Antrum*, there is only an oblong Depression at the Side of the Nostrils.

OSSA PALATI are commonly described as two small square Bones, at the Back-part of the Palate or Roof of the Mouth, though they are of much greater Extent, being continued up the Back-part of the Nostrils to the Orbit (*a*). Each Palate-bone may therefore be divided into four Parts, the Palate Square-bone, the pterygoid Process, nasal *Lamella*, and orbital Process.

The Square-bone is unequally concave, for enlarging both the Mouth and Cavity of the Nose. The upper Part of its internal Edge rises into a Spine, after the same Manner as the Palate *Lamella* of the *Oss maxillare*

(a) *Eustach.* Tab. 47. Fig. 1. 3. 6. 7. 8. — *Vidus Vidius.* De Anat. lib. 2. cap. 2. Explicat. Tab. 6. Fig. 19. — *Win-*
slow, Memoires de l'Acad. des Sciences, 1720.

lare does, to be joined with the *Vomer*.—Its anterior Edge is unequally ragged, for its firmer Connexion with the Palate Process of the *Os maxillare*.—The internal Edge is thicker than the rest, and of an unequal Surface, for its Conjunction with its Fellow of the other Side.—Behind, this Bone is somewhat in Form of a Crescent, and thick, for the firmer Connexion of the *Velum pendulum palati*; the internal Point being produced backwards, to afford Origin to the *Musculus palato-staphylinus* or *azygos*.—This Square-bone is well distinguished from the *pterygoid* Process by a perpendicular *Fossa*, which, applied to such another in the *Os maxillare*, forms a Passage for the palatine Branch of the fifth Pair of Nerves; and by another small Hole behind this, through which a Twig of the same Nerve passes.

The *pterygoid* Process is somewhat triangular, having a broad Base, and ending smaller above. The Back-part of this Process has three *Fossæ* formed in it; the two lateral receive the Ends of the two Plates of the sphenoid Bone, that are commonly compared to a Bat's Wing; the middle *Fossa* makes up part of what is commonly called the *Fossa pterygoidea*: the Fore-side of this palatine pterygoid Process is an irregular Concave, where it receives the Back-part of the *Tuberositas maxillaris*.—Frequently several small Holes may be observed in this triangular Process, particularly one near the Middle of its Base, which a little above communicates

municates with the common and proper Holes of this Bone already taken notice of.

The *Nasal Lamella* is extremely thin and brittle, and arises upwards from the upper Side of the external Edge of the Square-bone, and from the narrow Extremity of the *pterygoid* Process; where it is so weak, and, at the same time, so firmly fixed to the *Os maxillare*, as to be very liable to be broken, in separating the Bones.—From the Part where this *Lamella* rises, it runs up broad on the Inside of the *Tuberositas maxillaris*, to form a considerable Share of the Sides of the *Sinus maxillaris*, and to close up the Space between the *sphenoid* and the great Bulge of the maxillary Bone, where there would otherwise be a large Slit opening into the Nostrils (a).—From the middle internal Side of this thin Plate, a cross Ridge placed on such another of the maxillary Bone is extended; on it, the Back-part of the *Os spongiosum inferius* rests:—Along the Outside of this Plate, the perpendicular *Fossa* made by the Palate Nerve is observable.

At the upper Part of this *Nasal Lamella*, the Palate Bone divides into two Processes, which I already named *orbital*;—between which and the Body of the *sphenoid* Bone, that Hole is formed, which I mentioned as the last of the Holes common to the *sphenoid* Bone.—Sometimes this Hole is wholly formed in the *Os palati*, by a cross Plate going

(a) *Albin. De Offib.* § 88.

going from the one orbital Process to the other. A Nerve, Artery and Vein belonging to the Nostrils pass here. — The anterior of the two orbital Processes is the largest, and has its Fore-part contiguous to the Back-part of the *Sinus maxillaris*, and its upper Surface appears in the Bottom of the Orbit, behind the Back-part of the *Os maxillare* and the *Os planum*. — It has Cells behind resembling those of the *ethmoid* Bone, to which it is contiguous; it is placed on the Aperture of the *Sinus sphenoidalis*, so as to leave only a round Hole at its upper Fore-part. — The other Part of the orbital Process is extended along the internal Side of the upper Back-part of the *Tuberositas maxillaris*, to the Base of the *sphenoid* Bone, between the Root of the *Processus azygos* and the pterygoid Process.

The Palate, square Part of this Palate Bone, and its pterygoid Process, are firm and strong, with some *Cancelli*; but the Nasal Plate and orbital Processes are very thin and brittle.

The *Ossa palati* are joined to the *Ossa maxillaria*, by the Fore-edge of the Palate Square-bone, by the *transverse Palate Suture*: — By their thin Nasal *Lamellæ*, and Part of their orbital Processes, to the same Bones, by the *Palato-maxillares* Sutures: — By their pterygoid Processes, and Back-part of the Nasal *Lamella*, to the *Alæ vesper-tilionum*, by the *sphenoid Suture*: — By the transverse Ridges of the Nasal *Lamellæ*, to the *Ossa spongiosa inferiora*, by Contact; hence frequently there is an intimate Union

of

of the Substance of these Bones in old Skulls : — By the orbital Processes, to the *Ossa plana* and *Cellulæ ethmoidæ*, by the *ethmoid Suture* : — To the Body of the *sphenoid Bone*, by the *sphenoid Suture* : — By the internal Edge of the Square-bones to each other, by the *longitudinal Palate Suture* ; and by their Nasal Spines to the *Vomer*, by the *spinous Suture*.

The Palate Bones form part of the Palate, Nostrils, Orbits, and *Fossæ pterygoideæ*, and they cover part of the *Sinus maxillares*, *sphenoidales* and *ethmoidei*.

These Bones are very complete in a new-born Infant, the Nasal *Lamellæ* being thicker and stronger than in Adults ; but the orbital Processes have not the Cells which appear in the Bones of Adults.

When we are acquainted with the History of these Bones, the Reason is evident, why the Eyes are so much affected in Ulcers of the Palate, as to be often attended with Blindness, which frequently happens in an ill-managed *Lues Venerea* ; or why, on the other hand, the Palate suffers from an *Ægylops* (a).

OSSA TURBINATA, or *spongiosa inferiora*, resemble the superior *Ossa spongiosa* in Shape and Substance, but have their anterior and upper Edges contiguous to the transverse Ridges of the Nasal Processes of the *maxillary* and *Palate Bones*. — From their upper straight Edge, two small Processes stand

N out :

(a) *Hoffman*, in *Ephemerid. German. Cent. 1. and 2. observ. 135.*

out: The posterior, which is the broadest, descends to cover some of the *Antrum Highmorianum*; the anterior rises up to join the *Os unguis*, and to make up part of the *lacrymal Duct*.

Below the spongy Bones already mentioned, there are sometimes two others, one in each Nostril, which seem to be a Production of the Sides of the maxillary *Sinus* turned downwards (*a*). When this third sort of spongy Bones is found, the middle one of the three in each Nostril is the largest, and the lowest is the smallest.—Besides all these, there are often several other small Bones standing out into the Nostrils, that, from their Shape, might also deserve the Name of *Turbinata*, but are uncertain in their Bulk, Situation, and Number (*b*).

The Names of these Bones sufficiently declare their spongy Substance, which has no firm external Plate covering it.

They are joined to the *Ossa maxillaria, palati* and *unguis* in old Subjects, by a firm Union of Substance; and as this happens also frequently in People of no great Age, some (*c*) are of Opinion, that they should be esteemed part of the Palate-bones; others (*d*) think, that since their upper Edge is continued by a Plate to a Part of the *Os ethmoides*, they ought to be esteemed to be a Part of this Bone.

Their

(*a*) Cowper in Drake's Anthropolog. Book 3. Chap. 10.

(*b*) Santorin. Observat. Anatomic. cap. 5. § 9.

(*c*) Id. ibid. cap. 5. § 7.

(*d*) Hunauld. in Memoires de l'Acad. des Sciences, 1730.

Their Use is, to straiten the Nostrials, to afford a large Surface for extending the Organ of Smelling, to cover part of the *Antra maxillaria*, and to assist in forming the Under-part of the lacrymal Ducts, the Orifices of which into the Nose are concealed by these Bones.

The *Ossa turbinata* are complete even in a new-born Infant.

VOMER, or Bone resembling a Ploughshare, is the thirteenth of the Upper Jaw, without a Fellow, forming the Lower and Back-parts of the *Septum narium* (a).

The Figure of this Bone is an irregular Rhomboid.—Its Sides are flat and smooth.—Its posterior Edge appears in an oblique Direction at the Back-part of the Nostrials.—The upper one is firmly united to the Base of the *sphenoid* Bone, and to the Nasal *Lamella* of the *ethmoid*; and, when it can be got separated, is hollow, for receiving the *Processus azygos* of the *Sphenoid*.—The anterior Edge has a long Furrow in it, where the middle Cartilage of the Nose enters.—The lower Edge is firmly united to the Nasal Spines of the maxillary and Palate Bones.—These Edges of this Bone are much thicker than its Middle, which is as thin as the finest Paper; by which, and the firm Union or Connexion this Bone has above and below, it can very seldom be separated entire in Adults: But, in a Child, it is much more easily separated entire;

N 2

wherefore

(a) *Columb. De re Anatom. lib. 1, cap. 8.*—*Fallop. Observat. Anatom.*

wherefore I shall examine all its Parts of such a Subject.

Its Situation is not always perpendicular, but often inclined, as well as the Nasal *Lamella ethmoidea*, to one Side.

The *Vomer* is convex at its upper Part, and then is streight, as it is extended downwards and forwards where it is composed of two Plates; the Edges of which have a great Number of small Processes, disposed somewhat like the Teeth of a Saw, but more irregularly, and several of them are reflected back. Between these Plates a deep *Fossa* is left, which, so far as the Top of the Curvature, is wide, and has strong Sides, for receiving the *Processus azygos* of the *sphenoid* Bone. Beyond the Arch forwards, the *Fossa* is narrower and shallower gradually to the Point of the Bone, receiving for some way the Nasal *Lamella ethmoidea*; which, after the Ossification is compleat, is so closely united to the *Vomer* by the little Processes piercing into its Substance, as to prevent any Separation; on which account it has been esteemed by some (a) a Part of the ethmoid Bone. The middle Cartilage of the Nose fills up what remains of the *Fossa* at its Fore-part.—The posterior Edge of the *Vomer*, which appears above the Back-part of the Palate-bones, is broader above; but as it descends forwards, becomes thinner, though it is still solid and firm.—The lower Edge of this Bone, which rests on the Nasal
Spine

(a) *Lieutaud. Essais Anatomiques* 1. sect. l'Os ethmoïde.

Spine of the *Offa palati* and *Maxillaria*, has a little Furrow on each Side of a small middle Ridge, answering to the Spines of the Bones of different Sides, and the Interstice between them. This Edge, and the upper one meet in the pointed Fore-end of this Bone.

The Body of the *Vomer* has a smooth Surface, and solid, but thin Substance; and towards its Sides, where it is thickest, some *Cancelli* may be observed, when the Bone is broken.

It is joined above to the *sphenoid* and *ethmoid* Bones, and to the middle Cartilage of the Nose, by *Schindylesis*;—below, to the maxillary and Palate Bones, by the *spinous* Suture.

The *Vomer* divides the Nostrils, enlarges the Organ of Smelling, by allowing Place for expanding the *Membrana narium* on its Sides, and sustains the Palate *Lamellæ* of the *Offa maxillaria* and *palati*, which otherwise might be in hazard of being pressed into the Nostrils; while the *Vomer* is secured from shuffling to one Side or other by the double *Schindylesis*, by which it is joined to the Bones above and below.

These then are all the Bones which compose the Upper Jaw, except the Teeth, which are so much a-kin to those of the *Maxilla inferior*, that I chuse to make one Description serve for both, in which the Differences observable in them shall be remarked, after the second Part of the Face, the Lower Jaw, is examined; because the

Structure of the Teeth cannot be well understood, until the Case in which they are set is explained.

MAXILLA INFERIOR *, the Lower Jaw, consists only of one moveable Bone, and sixteen Teeth incased into it.

This Bone, which is somewhat of the Figure of the *Greek* Letter ν , is situated at the lower Part of the Face, so as its convex middle Part is forwards, and its Legs are stretched back. It is commonly divided into the *Chin*, Sides, and Processes. The *Chin* is the middle Fore-part, the Extent of which to each Side is marked on the external Surface by the Holes observable there, and internally by the Beginning of an oblique Ridge.—Beyond these the *Sides* appear, and are continued till the Bone, by bending upwards, begins to form the Processes.

On the Fore-part of the *Chin*, a transverse Ridge appears in the Middle, on each Side of which the *Musculi quadrati*, or *Depressores labii inferioris*, and the *Levatores labii inferioris*, depress the Bone: And below these Prints, a small Rising may be observed, where the *Depressores* commence.—On the Back-part of the *Chin*, sometimes three, always two, small Protuberances appear in the Middle. To the uppermost, when it is seen, the *Frænum* of the Tongue is connected. From the middle one, the *Musculi genioglossi* rise; and from the lowest, the *Geniohyoidei* have their Origin. Below the

* *Τίς, αἰχάν, Mandibula, facies.*

the last, we see two rough Sinuosities formed by the *digastric* Muscles.

At the Lower and Fore part of the external Surface of each Side of the Lower Jaw, a small Eminence may be observed, where the *Depressor labiorum communis* rises. Near the upper Edge of the Side a Ridge runs length-ways, to which the under Part of the *Musculus Buccinator* is connected.——Internally, towards the upper Edge of each Side, another Ridge appears, from which the *Mylohyoidei* have their Origin, and to which the internal Membrane of the Gums adheres.

In the upper Edge of both Chin and Sides are a great many deep Pits or Sockets, for receiving the Roots of the Teeth. The Number and Magnitude of these Sockets are various, because of the different Number, as well of the Teeth themselves, as of their Roots, in different People. These Sockets in this Lower Jaw, as well as in the Upper one, become less deep as old Age comes on; when freed from the Teeth by any means, they are some time after filled up with an osseous Net-work, which at last becomes entirely solid, and as smooth as any other Part of the Bone; so that in a great many old Jaws one cannot observe a Vestige of the Sockets: But then the Jaw becomes less, and much narrower (a). — Hence we may know why the Chin and Nose of edentulous People are much nearer than before the Teeth were lost; while their Lips either
fall

(a) *Vesal. Anat. lib. 1. cap. 10.*

fall in towards the Mouth, or stand prominent forwards.—When new Teeth are protruded, new Sockets are formed (a).—The lower Edge of the Chin and Sides is smooth and equal, and is commonly called the *Base* of the Lower Jaw.—The Ends of the Base, where the Jaw turns upwards, are called its *Angles*; the external Surface of each of which has several Inequalities upon it, where the *Masseter* Muscle is inserted; as the internal Surface also has, where the *Pterygoideus internus* is fixed.

The Processes are two on each Side.—The anterior sharp thin *coronoid Apophyses* have the *crotaphite* Muscles inserted into them.—The posterior Processes or *Condyles* * terminate in an oblong smooth Head, supported by a *Cervix*. The Heads whose greatest Length is transverse, and whose Convexity is turned forwards, are tipped with a Cartilage, as the articulated Parts of all other moved Bones are.—The Fore-part of the Root and Neck of these *condyloid* Processes are a little hollow and rough, where the *Pterygoidei externi* Muscles are inserted.

The *Foramina* of the Lower Jaw are two on each Side; one at the Root of the Processes internally, where a large Branch of the third Branch of the fifth Pair of Nerves enters with an Artery, and a Vein returns. A small sharp Process frequently juts out backwards from the Edge at the Fore-part of this Hole, to which a Ligament extended

(a) Fallop. Observ. Anat.
* Articulatorii.

ed from the temporal Bone is fixed (a), which saves the Nerve and Vessels from being too much pressed by the *pterygoid* Muscles. — From the lower Side of this Hole, either a small superficial Canal or a Furrow descends, where a small Branch of the Nerve is lodged, in its Way to the *Mylo-hyoideus* Muscle and sublingual Gland (b). — The other Hole is external, at the Confines of the Chin, where Branches of the Nerve and Vessels come out. — The Canal betwixt these two Holes is formed in the Middle of the Substance of the Bone, and is pierced by a great Number of small Holes by which the Nerves and Blood-vessels of the *Cancelli* and Teeth pass. This Channel is continued a little further than the external Hole at the Chin. — On account of the Vessels and Nerves in this Canal, Fractures of the Lower Jaw may be attended with dangerous Symptoms.

The Surface of the Lower Jaw is hard and firm, except at the spungy Sockets, where however it is stronger than the Upper Jaw. — Its internal Substance is cellular, without any *Septum* between the *Cancelli* in its Middle. — At the Base, especially of the Chin, where this Bone is most exposed to Injuries, the solid Sides of it are thick, compact, and hard.

The Lower Jaw generally receives the Roots of sixteen Teeth into its Sockets, by *Gomphosis*; and its *condyloid* Processes, covered

(a) *Weitbrecht*. Syndesmolog. Fig. 32. 1.

(b) *Palfyn*. Anat. Chirur. traité 5. chap. 6.

vered with Cartilage, are articulated with the *Ossa temporum*, by what I called the third Species of *Ginglimus*, but in a Manner that is not commonly described right: For, as was already mentioned in the Description of the temporal Bones, not only the Fore-part of the Cavity between the *zygomatic*, *auditory* and *vaginal* Processes, but also the adjoining Tubercle at the Root of the *zygomatic* Process of each *Os temporum* is covered with a smooth Cartilage, for this Articulation. — Here also an intermediate moveable Cartilage is placed, which being thin in the Middle, and thick at the Edges, is concave on both Sides; and is connected so firmly by Ligaments to each *Condyle*, as to follow the Motions of the *Condyle*; and so loosely to the *Os temporum*, as readily to change its Situation from the Cavity to the Tubercle, and to return again; while the common Ligament of the Articulation affords Space enough for such a Change of Place backwards and forwards; but, like other Ligaments of the Joints by *Ginglimus*, is stronger and shorter at the Sides, to confine the lateral Motions.

When therefore the Teeth of both Jaws coincide, the *Condyles* are lodged securely in the temporal Cavities, but their Motions to either Side must be confined both by the Firmness of the Ligaments, and the rising Brims which are on each Side of the Cavities. — When the Jaw is brought directly forwards, the *Condyles* and intermediate Cartilages descend and advance forwards

upon

upon the Tubercles.——In this Situation the lateral Motions are a little more free than in the former one, from the want of rising Brims to stop the Condyles.——When the Fore-teeth of the Lower Jaw are moved forwards, and to a Side, the Condyle of the opposite Side is either advanced from the Cavity to the Tubercle, while the Condyle of the same Side remains in the Cavity; or if both Condyles are on the Tubercles, when the Jaw is moved obliquely to a Side, the Condyle of the Side to which the Motion is made, slides back from the Tubercle to the Cavity.——When the Mouth is opened by the Descent of the Lower Jaw, the Fore-part of it, where the *depressing* Muscles are fixed, is drawn backwards, as well as downwards, while Resistance is made to the Angles moving backwards by the *Masseter* and *internal pterygoid* Muscles, and, at the same time, the *external Pterygoid* draw the Condyles and their moveable Cartilages forwards; and therefore, when the Mouth is opened, the Condyles are carried forwards upon the Tubercles, and the Axis of Motion of the Bone is a little above its Angles. But in this Situation there is less Resistance, than in any other, to the Condyles luxating forwards; a Disease which seldom happens, except when People are gaping too wide; and therefore the common Practice of Nurses, who support the Jaw of Infants when they are yawning, is reasonable.

able.—In chewing there is a Succession of the Motions above described (a).

Here a general Remark may be made, That where-ever moveable Cartilages are found in Joints, either the articulated Bones are of such a Figure, or so joined and fixed by their Ligaments, that little Motion would be allowed without such Cartilages; or else some Motions are necessary to the right Use of the Member, which the Form of the Articulation would not otherwise admit of. This will more fully appear after the other Joints with such Cartilages are described.

In a Child born to the full Time the Lower Jaw is composed of two Bones, connected by a thin Cartilage in the Middle of the Chin, which gradually ossifies, and the two Bones intimately unite.—In each of these Bones there are five Sockets for Teeth, as in the Upper Jaw.

After I have thus described the Incafenient of the Teeth, the Insertion of so many Muscles of the Tongue, and of the *Oshyoides*, the Connexion of the Membrane of the Tongue to the maxillary Bone, and the Motions of this Bone; it is easy to see, that the Lower Jaw must be a principal Instrument in Manducation, Deglutition, and Speech.

The

(a) For a more full Account of this Articulation, vid. *Edinburgh Medical Essays and Observ.* Vol. I. Art. II. and *Memoires de l'Acad. des Sciences*, 1744.

The *TEETH* are the hard white Bodies placed in the Sockets of both Jaws. Their Number is generally sixteen above, and as many below; though some People have more, others have fewer.

The broad thick Part of the Teeth which appears without the Socket, is the *Base* or *Body* *. — The smaller Processes sunk into the *Maxillæ*, are the *Roots* or *Fangs*. — At the Place where the Base ends, and the Roots begin, there is generally a small circular Depression, which some call the *Neck* or *Collar*.

Without the Gums the Teeth are covered with no Membrane, and they are said to have no proper *Periosteum* within the Sockets; but that is supplied by the reflected Membrane of the Gums; which, after a good Injection, may be evidently seen in a young Subject, even when it is dried; and it may be discovered in any Tooth recently pulled, by macerating it in Water (a). The Adhesion of this Membrane to these Roots is strengthened by the small Furrows observable on them.

Each Tooth is composed of its *Cortex*, or *Enamel*, and an internal bony Substance. The *Cortex* has no Cavity, or Place for Marrow; and is so solid and hard, that Saws or Files can with Difficulty make Impression on it. It is thickest upon the Base, and gradually, as the Roots turn smaller, becomes thinner, but not proportionally to the Difference of the Size of the Base and

O

Roots.

* *Corona*.

(a) *Cowper*, Anatom. Explicat. Tab. 92. Fig. 7. lit. E.

Roots.—The Fibres of this Enamel are all perpendicular to the internal Substance, and are streight on the Base, but at the Sides are arched with the convex Part towards the Roots; which makes the Teeth resist the Compression of any hard Body between the Jaws, with less Danger of breaking these Fibres, than if they had been situated transversely. The spongy Sockets in which the Teeth are placed, likewise serve better to prevent such an Injury, than a more solid Base would have done. — Notwithstanding the great Hardness of this *Cortex*, it is wasted by Manducation. Hence the sharp Edges of some Teeth are blunted, and made broad, while the rough Surfaces of others are made smooth and flat.

The bony Part of the Teeth has its Fibres running streight, according to the Length of the Teeth. When it is exposed to the Air, by the breaking or falling off of the hard *Cortex*, it soon corrupts. And thence carious Teeth are often all hollow within, when a very small Hole appears only externally.

The Teeth have Canals formed in their Middle, wherein their Nerves and Blood-vessels are lodged; which they certainly need, being constantly wasted by the Attrition they are subjected to in Manducation, and for their further Growth, not only after they first appear, but even in Adults; as is evident when a Tooth is taken out: For then the opposite one becomes longer, and these on each Side of
the

the empty Socket turn broader; so that when the Jaws are brought together, it is scarce observable where the Tooth is wanting (a).

The Vessels are easily traced as long as they are in the large Channel, but can scarce be observed in their Distribution from that to the Substance of the Teeth of Adults. *Ruyfch* (b) however affirms, that after Injection he could trace the Arteries into the hardest Part of the Teeth: And *Lewenhoeck* (c) suspected the Fibres of the Cortex to be Vessels. In Children I have frequently injected the Vessels of the Teeth as far as their Base: And in such as are not entirely ossified, one can with a lucky Injection fill so many Vessels, as to make the Inside of the cortical Part appear perfectly red.—This plentiful Supply of Vessels must expose the Teeth to the same Disorders that attack other vascular Parts; and such Teeth as have the greatest Number of Vessels, must have the most numerous Chances of being seized with these Diseases.

Every Root of each Tooth has such a distinct Canal, with Vessels and Nerves in it. These Canals in the Teeth with more than one Root, come nearer each other, as they approach the Base of the Tooth; and at last are only separated by very thin Plates, which being generally incompleat, allow a Communication of all the Canals; and frequently

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(a) *Ingraf.* de Tumor, cap. 1. p. 24. 25. 26.

(b) *Thesaur.* 10. num. 27.

(c) *Arcan. Natur. Continuat. Epist.* p. 3.

ly one common Cavity only appears within the Base, in which a pulpy Substance composed of Nerves and Vessels is lodged. The Condition therefore of the Nerves here, bears a strong Analogy to that of the cutaneous Nerves which serve for the Sensation of Touching. And since the *Cuticula* can be rubbed off or cut without Pain, allows the Nerves to be affected by Heat or Cold, and transmits acid or austere Liquors, that blunt the Touch considerably, and give an uneasy Sensation at the same time; and that several Substances, notwithstanding this interposed Membrane, do create a painful *Tremor*, by their numerous or frequently repeated Impulses; when, I say, all this is considered, the analogous *Phænomena* in the Teeth, which the Ancients disputed so much about, will appear to be of no difficult Solution.

The Entry of the Canals for these Vessels, is a small Hole placed a little to a Side of the extreme Point of each Root; sometimes, especially in old People, this Hole is entirely closed up, and consequently the Nerves and Blood-vessels are destroyed (*a*).

The Teeth are seen for a considerable Time in form of *Mucus* contained in a Membrane; afterwards a thin cortical Plate, and some few osseous Layers appear within the Membrane, with a large Cavity filled with *Mucus* in the Middle; and gradually this exterior Shell turns thicker, the Cavity decreases, the
Quantity

(*a*) *De la Hirè Histoire de l'Acad. des Sciences, 1699.*

Quantity of *Mucus* is lessened, and this Induration proceeds, till all the Body is formed; from which the Roots are afterwards produced.

In young Subjects, different *Stamina* or Rudiments of Teeth are to be observed. Those next the Gums hinder ordinarily the deeper-seated ones from making their Way out, while these prevent the former from sending out Roots, or from entering deep into the bony Sockets of the Jaws; by which they come to be less fixed.

Children are seldom born with Teeth; but at two Years of Age they have twenty; and their Number does not increase till they are about seven Years old, when the Teeth that first made their Way through the Gums, are thrust out by others that have been formed deeper in the Jaw, and some more of the Teeth begin to discover themselves farther back in the Mouth. About fourteen Years of Age, some more of the first Crop are shed, and the Number is increased.—This Shedding of the Teeth is of good Use; for if the first had remained, they would have stood at a great Distance one from another; because the Teeth are too hard in their outer Crust, to increase so fast as the Jaws do. Whereas both the second Layer, and the Teeth that come out late, meeting, while they are soft, with a considerable Resistance to their Growth in Length, from those situated upon them, necessarily come out broad;

and fit to make that close Guard to the Mouth †, which they now form.

The Teeth are joined to the Sockets by *Gomphosis*, and the Gums contribute to fix them there; as is evident by the Teeth falling out when the Gums are any way destroyed, or made too spongy; as in the *Scurvy* or *Salivations*: Whence several Authors class this Articulation with the *Syffarcosis*.

The Uses of the Teeth are to masticate our Aliment, and to assist us in the Pronunciation of several Letters.

Though the Teeth so far agree in their Structure, yet, because of some Things wherein they differ, they are generally divided into three Classes, viz. *Incisores*, *Canini*, and *Molares*.

The *Incisores* * are the four Fore-teeth in each Jaw, receiving their Name from their Office of cutting our Aliment; for which they are excellently adapted, being each formed into a sharp-cutting Edge at their *Base*, by their Fore-side turning inwards there, while they are sloped down and hollowed behind †; so that they have the Form of Wedges; and therefore their Power of acting must be considerably increased.—— Seeing in the Action of the *Incisores*, a perpendicular Compression is only necessary, without any lateral Motion, they are not so firmly

† φραγμός

* Γελασῖνοι, τομίκοι, διχασῆρες, κτίνες, τομῆς, πρωσθιοί, δεξιῆς, Risorii, quaterii, primi, primores, anteriores, acuti.

† Ολμίσχος.

firmly fixed in their Sockets as the other Teeth are, each having only one short Root.

The Incisores of the Upper Jaw, especially the two middle ones †, are broader and longer generally than those of the Under Jaw.

In a new-born Infant, the outer Shell of the Body of these Teeth is only hardened.

—Afterwards, when the *Stamina* of two Sets are formed, each has its own Socket, those nearest to the Gums being placed more forward, and the others are lodged farther back within the Jaw-bones.

Canini ||, from the Resemblance to Dogs Tusks, are one on each Side of the *Incisores* in each Jaw.—The two in the Upper Jaw are called *Eye-teeth*, from the Communication of Nerves which is said to be betwixt them and the Eyes.—The two in the Lower Jaw are named *angular* or *Wike-teeth*, because they support the Angles of the Mouth.

The *Canini* are broader, longer, and stronger, than the *Incisores*.—Their Bases are formed into a sharp Edge, as the *Incisores* are; only that the Edge rises into a Point in the Middle.—Each of them has generally but one long Root, though sometimes they have two (a). The Roots are crooked towards the End.—The *Canini* of the Upper Jaw are larger, longer, and with more crooked Roots, than those of the Under Jaw.—The Form of their ~~Base~~ is fit both for piercing and cutting, and the long crooked Root of each, makes it secure in the Socket.

The

† Duales.

|| Κυνόδοντες, Risorii, fractorii, collaterales, columellares.

(a) Fauchard, Chirurgien Dentiste, chap. 1.

The *Canini* of a Child are in much the same Condition as the *Incisores* are.

The *Dentes molares*, or *Grinders* †, which have got their Name because they grind our Food, are generally five in each Side of each Jaw; in all twenty. Their Bases are broader, more scabrous, and with a thinner cortical Substance, and they have more Roots, than the other Teeth.

The Base of the first Grinder has an Edge pointed in the middle, on its Outside, resembling the *Canini*; from which it slopes inwards, till it rises again into a Point.—It has generally but one Root, which sometimes is long and crooked at its Point.

The second *Dens molaris* has two Points on its Base, rising near equally on its Out and In Side.—It has two Roots, either separate or run together, but shorter than the Root of the first.—These two anterior Grinders are much smaller than the three that are placed farther back in the Mouth.

The third and fourth are very broad in their Bases, with four or five Points standing out; and they have three or more Roots.

The fifth, called commonly *Dens sapientiæ* *, from its coming through the Gums later than the other Grinders, has four Points on its Base, which is not so large as the Base of the third and fourth, and its Roots are less numerous.

The

† Μυλίται, γόμφοι, μύλος, πλατῆς, φρασῆρες, maxillares, molares, clavales, buccarum.

* Σωφρονισῆρες, κραντῆρες, ὀψίγονοι, sensus, intellectus, serotini, atatem complentes, genuini, moderatores.

The *Incisores* of the Upper Jaw being broader than those of the Lower Jaw, make the superior Grinders to be placed so much farther back than the lower ones, that when they are brought together, by shutting the Mouth, the Points of the Grinders of the one Jaw enter into the Depressions of the opposite Grinders, and they are all equally applied to each other, notwithstanding the Inequality of their Surface.

The numerous Roots of the *Dentes molares* prevent their loosening by the lateral Pressure they suffer in grinding; and as the Sockets in the Upper Jaw are more spongy, and the Teeth are more liable, by their Situation, to fall out (*a*), the Grinders there have more numerous and more separated Roots than in the Lower Jaw (*b*). The Number however of the Roots of the Teeth of both Jaws is very uncertain; sometimes they are more, sometimes fewer; frequently several Roots are joined together; at other times they are all distinct. The Disposition of such as are distinct, is also various; for in some the Roots stand out straight, in others they separate, and in others again they are crooked inwards. When the Roots are united, we can still distinguish them, by remarking the Number of small Holes at their Points, which determine the Number of Roots the Tooth ought to be reckoned to have.

At

(*a*) *Galen. de Ossib. cap. 5.*

(*b*) *Fauchard. Chirurg. Dent. chap. 1.*

At the Time of Birth, only two *Dentes molares* in each Jaw have begun to ossify, and that at little more than the Base, which has several sharp Points standing out from it.—The temporaneous Grinders are placed more directly upon the internal Set than the other two Classes are ; sometimes there is a Piece of the Bone of the Jaws between the two Sets; in other Children, the two Sets have nothing interposed between them.

From what has been said, the Answers to the following Queries may be given.

Why are Children subject to Salivation, Fevers, Convulsion, Vomiting, Purging, &c. when their Teeth are breeding or cutting the Gums.

Why in Children do the *Dentes incisores* first cut the Gums, the *Canini* next, and *Molares* last?

Why do Children shed their Teeth at a certain Age?

Wherefore have these *temporaneous* Teeth generally no Roots, or very small ones?

Why have these first Teeth sometimes Roots?

Why do these Roots frequently come outwards through the Gums?

Whence come *Butter* or *Buck* Teeth?

How do these Teeth sometimes go into the natural Row with the others, after pulling a rotten Tooth near them?

How have some People got two Rows of Teeth in one or both Jaws? (a)

Why

(a) *Blas. Comment. ad Velling. syntagm. cap. 13.*

Why do the Teeth of old People loosen, and then drop out entire?

Whence arise the new Sets of Teeth which several old People obtain (a)?

Why are not the Gums of toothless old People torn by the hard Sockets in chewing?

Why are the Teeth insensible when slightly filed or rasped?

How come they to be sensible of Heat or Cold, to be set on Edge by Acids, or to give such an uneasy Sensation when gritty or sandy Substances are rubbed between them?

What is the Reason of some Persons dying convulsed, upon rasping or filing down an overgrown Tooth (b)?

What Parts are affected in the Tooth-ach?

Why are the *Dentes molares* most subject to that Disease?

How do the Teeth break and moulder away without any Pain in some People, and not in others?

Whence proceeds the violent obstinate Hemorrhagy which sometimes attends the drawing of Teeth (c)?

Why is it more difficult and dangerous to draw the Eye-teeth than any other?

What

(a) Hofman. in van Horn. Microcosm. p. 38.

(b) Bartholin. Anat. reformat. lib. iv. cap. 12.

(c) Pare, livre 6. chap. 2. -----Rollinc. lib. 2. cap. 27. & 30. -----Moevii fundam. Medicin. cap. 9. -----Ephemerid. German. Dec. 1. ann. 3. obs. 316. -----Fauchard. Chirurg. Dentiste, Tom. 1. chap. 23. observ. 7.

What makes it impossible frequently to draw *Grinders*, without bringing away Part of the Jaw-bone with them, or breaking the Fangs?

Why have small Worms been sometimes found in carious Teeth (a)?

Why do Teeth, soon replaced after being extracted from the Sockets, become again fixed in the Sockets. (c)?

According to the Division made of the Skeleton, we should now proceed to the Description of the Trunk of the Body: but must first consider a Bone, which cannot well be said to belong to either the Head or the Trunk; nor is it immediately joined to any other, and therefore is very seldom preserved with Skeletons. However, it is generally described by Authors, after the Bones of the Face: In obedience therefore to the prevailing Method, I shall next examine the Structure of

The *OS HYOIDES* †, which is situated horizontally between the Root of the Tongue, and the *Larynx*. It is properly enough named *Hyoides*, from the Resemblance it bears to the Greek Letter υ, and may, for a clearer Demonstration of its

(a) *Jacobæus*, in *Act Hafn.* vol. 5. obs. 108.-----*Pecklin.* *Observ. Medic.* lib. 2. observ. 36,----*Bartholin.* *Hist. Medic.* cent. 3. hist. 96.

(b) *De la Motte* *Chirurgie*, tome 1. chap. 4. obs. 2.----*Fauchard*, *Chirurgien Dentiste*, tome 1. chap. 29.

(†) *Hypsyloides*, *Lambdoides*, *παρυστερν, γαρυστήριον*, os gutturis, os linguæ, os morfus *Adami*, assessor, os laudæ, bicornæ.

its Structure be distinguished into its *Body*, *Cornua*, and *Appendices*.

The *Body* is the middle broad Part, convex before, and hollow behind.—The convex Fore-part is divided into two, by a Ridge, into the Middle of which the *Mylo-hyoidei*, and into the Sides the *Stylo-hyoidei* Muscles are inserted.—Above the Ridge, the Bone is horizontal, but pitted in in the Middle by the Insertion of the two *Genio-hyoidei* Muscles, and a little hollowed more laterally by the *Basio-glossi*.—Below the Ridge, it is convex but a little flattened in the Middle by the *Sterno-hyoidei*, and pitted more externally by the *Coraco-hyoidei*.—The Concavity behind faces backwards and downwards to receive the *Thyroid* Cartilage, when the *Larynx* and the *Os-hyoides* are pulled towards each other by the Action of the *Sterno-hyoidei* and *Hyo-thyroidei* Muscles; and to its upper Edge, the ligamentous Membranes of the *Epiglottis*, Tongue, and *Thyroid* Cartilage, are fixed.

The *Cornua* of the † *Os hyoides* are stretched backwards from each Side of its *Body*, where often a small Furrow points out the former Separation; for in younger Subjects, the *Body* and *Cornua* are not one continued Substance, as they come afterwards to be in Adults.—These *Cornua* are not always straight, nor of equal Length; their two plain Surfaces stand obliquely, sloping from above outwards and downwards.—Into the external, the *Ce-*
P *rato-glossus*

† Crura, Latera inferiora.

rato-glossus is inserted above, and the *Thyro-hyoideus* Muscle below; and to the one behind the ligamentous Membrane of the Tongue and *Larynx* adheres.—Each of the *Cornua* becomes gradually smaller, as it is extended from the Base; but ends in a round Tubercle, from which a moveable Cartilage stands out, which is connected to the upper Process of the *Cartilago Thyroidea*.

Where the Body of the *Os hyoides* joins on each Side with its *Cornua*, a small Styliform Process, called *Appendix* ‡, rises upwards and backwards, into which the *Musculi Stylo-hyoidei alteri*, and Part of the *Hyo-glossi* Muscles, are fixed. From each of them a Ligament is sometimes extended to the *Styloid* Processes of the temporal Bones, to keep the *Os hyoides* from being drawn too much forwards or downwards. The Part of this Ligament next to these Processes sometimes forms into several Cartilages, which afterwards ossify in old People. *Ruyfch* (a) says that he has seen this Ossification continued as far up as the styloid Processes, which were therefore joined to the *Os hyoides* by *Anchylosis*.

The Substance of the *Os hyoides* is cellular, but covered with a firm external Plate, which is of sufficient Strength to bear the Actions of so many Muscles as are inserted into it.

It

‡ *Crura superiora, Latera superiora, Ossa graniformia.*
(a) *Advers. Anat. Dec. 3. § 9.*

It is not articulated with any Bone of the Body, except by means of the Muscles and Ligaments mentioned.

The Use of the *Os hyoides*, is to serve as a solid Lever for the Muscles to act with, in raising or depressing the Tongue and *Larynx*, or in enlarging and diminishing the Capacity of the *Fauces*.

At Birth, this Bone is in a cartilaginous State; excepting a small Point of Bone in the Middle of its Body, and in each of the *Cornua*. — The *Appendices* frequently remain cartilaginous many Years.

Of the TRUNK.

THE TRUNK consists of the *Spine*, *Pelvis*, and *Thorax*.

The SPINE * is the long Pile of Bones extended from the *Condyles* of the *Occiput*, to the End of the Rump. It somewhat resembles two unequal Pyramids joined in a common Base. It is not, however, streight; for its upper Part being drawn backwards by strong Muscles, it gradually advances forwards, to support the *OEsophagus*, Vessels of the Head, &c. Then it turns backwards, to make Place enough for the Heart and Lungs. It is next bended forwards, to support the *Viscera* of the *Abdomen*. It afterwards turns backwards, for the Enlargement of the *Pelvis*. And, lastly, it is re-

P 2

flected

* Ῥάχις, νάτον, ἀκανθα, ἱέρα σύριγγ, σωλήν, Tergum, Hominis Carina.

flected forwards, for sustaining the lowest great Gut.

The *Spine* is commonly divided into *true* and *false Vertebrae*; the former constituting the long upper Pyramid, which has its Base below, while the *false Vertebrae* make the shorter lower Pyramid, whose Base is above.

The *TRUE VERTEBRÆ* † are the twenty four upper Bones of the *Spine*, on which the several Motions of the Trunk of our Bodies are performed; from which Use they have justly got their Name.

Each of these *Vertebrae* is composed of its Body and Processes.

The Body is the thick spongy Fore-part, which is convex before, concave backwards, horizontal and plain in most of them above and below.—Numerous small Holes, especially on the fore and back Part of their Surface, give Passage to their Vessels, and allow the Ligaments to enter their Substance.—The Edges of the Body of each *Vertebra* are covered, especially at the Fore-part, with a Ring of Bone firmer and more solid than the Substance of the Body any where else. These Rings seem to be joined to the *Vertebrae* in the Form of *Epiphyses*, but are alledged by some (a) to be the Ligaments ossified. They are of great Use in preventing the spongy Bodies from being broken in the Motions of the Trunk.

Between

† Στροφαῖς, σπόδυς, Spondyli, ossa orbiculata; ossa vertebrata, verticula.

(a) Fallop. Observat. Anatom.

Between the Bodies of each two adjoining *Vertebræ*, a Substance between the Nature of Ligament and Cartilages is interposed; which seems to consist of concentrical curve Fibres, when it is cut horizontally; but when it is divided perpendicularly, the Fibres appear oblique and decussating each other (a).——The outer Part of the intervertebral Ligaments is the most solid and hard; and they gradually become softer, till they are almost in the Form of a glairy Liquor in the Center; and therefore these Substances were not improperly called *mucous Ligaments* by the Ancients (b). The external fibrous Part of each is capable of being greatly extended, and of being compressed into a very small Space, while the middle fluid Part is incompressible, or nearly so; and the Parts of this Ligament between the Circumference and Center approach in their Properties to either, in proportion to their more solid or more fluid Texture. The middle Point is therefore a *Fulcrum*, or *Pivot*, on which the Motion of a Ball and Socket may be made, with such a gradual yielding of the Substance of the Ligament; in which ever Direction our Spines are moved, as saves the Body from violent Shocks, and their dangerous Consequences (c).——This ligamento-cartilaginous Substance is firmly fixed

P 3

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(a) *Blancard. Anat. reform. cap. 32.——Weitbrecht. Syndesmolog. Sect. 4. § 15.*

(b) *Galen. de usu Part. lib. 12. cap. 16.*

(c) *Medical Essays and Observ. Vol. V. Art. 28.*

ed to the horizontal Surfaces of the Bodies of the *Vertebræ*, to connect them, in which it is assisted by a strong membranous Ligament, which lines all their concave Surface, and by still a stronger Ligament that covers all their anterior convex Surface.

We may lay it down as a general Rule, notwithstanding some Exceptions, That the *Bodies* of the *Vertebræ* are smaller and more solid above, but as they descend, they appear larger and more spongy; and that the Cartilages between them are thick, and the surrounding Ligaments strong in Proportion to the Largeness of the *Vertebræ*, and to the Quantity of Motion they perform: By which Disposition, the greater Weight is supported on the broadest best secured Base, and the Middle of our Body is allowed a large and secure Motion.

From each Side of the Body of each *Vertebra*, a bony Bridge is produced backwards, and to a Side; from the posterior End of which, one slanting Process rises, and another descends; the smooth, and what is generally the flattest Side of each of these four Processes, which are called the *oblique**, is covered with a smooth Cartilage; and the two lower ones of each *Vertebra* are fitted to, and articulated with the two upper or ascending oblique Processes of the *Vertebra* below.

From between the oblique Processes of each Side, the *Vertebra* is stretched out laterally into a Process that is named *Transverse*.

From

* *Articulatorii, minimi.*

From the back Part of the Roots of the two oblique, and of the transverse Processes of each Side, a broad oblique bony Plate is extended backwards, where these meet, the seventh Process of the *Vertebræ* takes its Rise, and stands out backwards: This being generally sharp-pointed and narrow-edged, has therefore been called *Spinal Process*; from which this whole Chain of Bones has got its Name.

Besides the common Ligament which lines all the internal Surface of the spinal Processes, as well as of the Bodies, there are particular Ligaments that connect the Processes of the contiguous *Vertebræ* together.

The Substance of the Processes is considerably stronger and firmer, and has a thicker external Plate than the Bodies of the *Vertebræ* have.

The seven Processes form a Concavity at their Fore-part, which, joined to the one, at the Back-part of the Bodies, makes a great *Foramen*, and the *Foramina* of all the *Vertebræ* form a long large Conduit *, for containing the *spinal Marrow*.—In the upper and lower Edge of each *lateral Bridge*, there is a Notch. These are so adapted to each other in the contiguous *Vertebræ*, as to form a round Hole in each Side between each two *Vertebræ*, through which the Nerves that proceed from the *Medulla spinalis*, and its Blood-vessels, pass.

The Articulations then of these *true Vertebræ* are plainly double; for their Bodies are joined by *Synchondrosis*, and their oblique

* Ἰερὰ στήριγξ, σωλήν, Canalis.

oblique Processes are articulated by the third sort of *Ginglimus*. Hence it is evident, that their Center of Motion is altered in different Positions of the Trunk: For when we bow forwards, the upper moved Part bears entirely on the Bodies of the *Vertebræ*: If we bend back, the oblique Processes support the Weight: If we recline to one Side, we rest upon the oblique Processes of that Side and Part of the Bodies: If we stand erect, all the Bodies and oblique Processes have their Share in our Support.

Hence it follows, 1. That because the Joints, of which the Spine is composed, are so numerous, the *Medulla spinalis*, Nerves, Blood-vessels, &c. are not liable to such Compression, and Over-stretching in the Motion of the Trunk of the Body, as they would otherwise be, since several *Vertebræ* must be concerned in every Motion of the Spine; and therefore a very small Curvature is made at the Conjunction of any two *Vertebræ*. 2. That an erect Posture is the surest and firmest, because the Surface of Contact of the *Fulcra* is largest, and the Weight is most perpendicular to them. 3. That the Muscles which move the Spine, act with greater Force in bringing the Trunk to an erect Posture, than in drawing it to any other: For in bending forwards, backwards, or to a Side, the Muscles which perform any of these Actions are nearer the Center of Motion; consequently the Lever with which they act is shorter, than when the Center of Motion

on is on the Part of the *Vertebra*, opposite to that where these Muscles are inserted; which is the Case in raising the Trunk. This is extremely necessary; since, in the Deflections of the Spine from a perpendicular Bearing, the Weight of the Body soon inclines it which Way we design; whereas, in raising us erect, this great Weight must be more than counteracted. 4. In calculating the Force exerted by the Muscles which move the Spine, we should always make Allowance for the Action of the Cartilages between the *Vertebræ*, which, in every Motion from an erect Posture, must be stretched on one Side, and compressed on the other, to both which they resist; whereas, in raising the Trunk, these Cartilages assist by their springy Force (*a*). 5. We are hence naturally led into the Reason of our Height of Stature increasing in the Morning, and diminishing at Night (*b*): For the intermediate Cartilages of the *Vertebræ* being pressed all Day long by the Weight of our Body, become more compact and thin in the Evening; but when they are relieved from this Pressure in the Night, they again expand themselves to their former Thickness; and seeing the Bulk of any Part must vary according to the different Distension or Repletion of the Vessels composing it, we may understand how we become taller after a plentiful Meal, and decrease after Fast-
ing

(*a*) *Borelli*, de motu Animal. pars 1. schol. ad Propos. 58.----*Parent*. Histoire de l'Acad. des Sciences, 1702.

(*b*) *Wasse*, Philosoph. Transact. Num. 383. Art. 1.

ing or Evacuations (a). 6. From the different Articulations of the Bodies, and oblique Processes of the *Vertebræ*, and the different Strength of the Ligaments, it is plain, that they are formed so as to allow much larger Motion forwards than backwards; this last being of much less Use, and might be dangerous, by overstretching the large Blood-vessels that are contiguous to the Bodies of the *Vertebræ*. 7. The intervertebral Cartilages shrivelling as they become more solid by Age, is the Cause why old People generally bow forwards, and cannot raise their Bodies to such an erect Posture as they had in their Youth.

The *Vertebræ*, at the ordinary Time of Birth, consist each of three bony Pieces, connected by Cartilages; to wit, the *Body*, which is not fully ossified, and a long crooked Bone on each Side; on which we see a small Share of the bony Bridge, the oblique Processes compleat, the beginning transverse Processes, and the oblique Plate, but no spinal Process; so that the Teguments are in no Danger of being hurt by the sharp Ends of these spinal Processes, while a Child is in its bended Posture in the Womb, nor while it is squeezed in the Birth.

From this general Mechanism of the Spine, an Account is easily deduced of all the different preternatural Curvatures which the Spine is capable of: For if one or more *Vertebræ*, or their Cartilages, are of unequal Thickness in opposite Sides, the Spine must be

(a) *Abbé Fontenu*, Histoire de l'Acad. des Sciences, 1723.

be reclined over to the thinner Side; which now sustaining the greatest Share of the Weight, must still be more compressed, consequently hindered from extending itself in proportion to the other Side, which, being too much freed of its Burden, has Liberty to enjoy a luxuriant Growth. The Causes on which such an Inequality of Thickness in different Sides of the *Vertebræ* depends, may vary: For either it may be owing to an Over-distension of the Vessels of one Side, and from thence a preternatural Increase of the Thickness of that Part; or, which more commonly is the Case, it may proceed from an Obstruction of the Vessels, by which the Application of proper Nourishment to the bony Substance is hindered, whether that Obstruction depends on the faulty Disposition of the Vessels or Fluids; or if it is produced by an unequal mechanical Pressure, occasioned by a paralytick Weakness of the Muscles and Ligaments, or by a spasmodic Over-action of the Muscles on any Side of the Spine, or by People continuing long, or putting themselves frequently into any particular Posture declining from the erect one: In all these Cases one common Effect follows, to wit, the *Vertebræ*, or their Cartilages, or both, turn thick on that Side where the Vessels are free, and remain thin on the other Side where the Vessels are straitened or obstructed.—Whenever any morbid Curvature is thus made, a second Turn, but in an opposite Direction to the former, must be formed.

med ; both because the Muscles on the convex Side of the Spine being stretched, must have a stronger natural Contraction to draw the Parts to which their Ends are fixed, and because the Patient makes Efforts to keep the Center of Gravity of his Body perpendicular to its Base, that the Muscles may be relieved from a constant violent contractile State, which always creates Uneasiness and Pain.

When once we understand how these crooked Spines are produced, there is little Difficulty in forming a just Prognosis ; and a proper Method of Cure may be easily contrived, which must vary as to the internal Medicines, according to the different Causes on which the Disease depends : But one general Indication must be pursued by Surgeons ; which is, to counteract the bending Force, by increasing the Compression on the convex Part of the Curvature, and diminishing it on the concave Side. The Manner of executing which in particular Cases must be different, and requires a very particular Examination of the Circumstances both of the Disease and Patient. In many such Cases, I have found some simple Directions, as to Postures in which the Patient's Body should be kept, of very great Advantage.

Though the *true Vertebrae* agree in the general Structure which I have hitherto described, yet because of several Specialities proper to a particular Number, they are commonly

commonly divided into three Classes, viz. *Cervical*, *Dorsal*, and *Lumbar*.

The *Cervical* † are the seven uppermost *Vertebræ*; which are distinguished from the rest by these Marks.—Their Bodies are smaller and more solid than any others, and flattened on the Fore-part, to make way for the *Oesophagus*; or rather this flat Figure is owing to the Pressure of that Pipe, and to the Action of the *longi Colli* and anterior *recti* Muscles.—They are also flat behind, where small Processes rise, to which Ligaments are fixed.—The upper Surface of the Body of each *Vertebra* is made hollow, by a slanting thin Process which is raised on each Side:—The lower Surface is also excavated, but in a different Manner; for here the posterior Edge is raised a little, and the one before is produced a considerable Way.—Hence we see how the Cartilages between those Bones are firmly connected, and their Articulations are secure.

The Cartilages between these *Vertebræ* are thick, especially at their Fore-part; which is one Reason why the *Vertebræ* advance forward as they descend, and have larger Motion.

The oblique Processes of these Bones of the Neck more justly deserve that Name, than those of any other *Vertebræ*. They are situated slanting; the upper ones having their smooth and almost flat Surfaces facing obliquely backwards and up-
Q
wards,

† Τράχηλος, αυχῆς, Colli.

wards, while the inferior oblique Processes have these Surfaces facing obliquely forwards and downwards.

The transverse Processes of these *Vertebræ* are framed in a different Manner from those of any other Bones of the Spine: For besides the common transverse Process rising from between the oblique Processes of each Side, there is a second one that comes out from the Side of the Body of each *Vertebra*; and these two Processes, after leaving a circular Hole for the Passage of the cervical Artery and Vein, unite, and are considerably hollowed at their upper Part, with rising Sides, to protect the Nerves that pass in the Hollow; and at last each Side terminates in an obtuse Point, for the Insertion of Muscles.

The spinal Processes of these cervical Bones stand nearly streight backwards, are shorter than those of any other *Vertebræ*, and are forked or double at their Ends; and hence allow a more convenient Insertion to Muscles.

The thick Cartilages between the Bodies of these *cervical Vertebræ*, the Obliquity of their *oblique* Processes, and the shortness and horizontal Situation of their *spinal* Processes, all conspire to allow them large Motion.

The Holes between the bony cross Bridges, for the Passage of the Nerves from the *Medulla spinalis*, have their largest Share formed in the lowest of the
two

two *Vertebræ*, to which they are common.

So far most of the cervical *Vertebræ* agree; but they have some particular Differences, which oblige us to consider them separately.

The first, from its Use of supporting the Head, has got the Name of *Atlas* †; and is also called *Epistropheæ*, from the Motion it performs on the second.

The *Atlas*, contrary to all the other *Vertebræ* of the Spine, has no Body; but, instead of it, there is a bony Arch.—In the convex Fore-part of which, a small Rising appears, where the *Musculi longi colli* are inserted; and, on each Side of this Protuberance, a small Cavity may be observed, where the *Recti interni minores* take their Rise. — The upper and lower Parts of the Arch are rough and unequal, where the Ligaments that connect this *Vertebra* to the *Os occipitis*, and to the second *Vertebra* are fixed. — The Back-part of the Arch is concave, smooth, and covered with a Cartilage, in a recent Subject, to receive the Tooth-like Process of the second *Vertebra*.—In a first *Vertebra* from which the second has been separated, this Hollow makes the Passage for the *Medulla spinalis* to seem much larger than it really is: On each Side of it a small rough Sinuosity may be remarked, where the Ligaments going to the Sides of the Tooth-like Process of the

Q 2

following

† Ἀτράγυλος.

following *Vertebra* are fastened; and on each Side, a small rough Protuberance and Depression is observable, where the transverse Ligament, which secures the Tooth-like Process in the Sinuosity, is fixed, and hinders that Process from injuring the *Medulla spinalis* in the Flexions of the Head.

The *Atlas* has as little spinal Process as Body; but, instead thereof, there is a large bony Arch, that the Muscles which pass over this *Vertebra* at that Place, might not be hurt in extending the Head. On the Back and Upper part of this Arch there are two Depressions, where the *Recti postici minores* take their Rise; and at the lower Part are two other Sinuosities, into which the Ligaments which connect this Bone to the following one are fixed.

The superior oblique Processes of this *Atlas* are large, oblong, and hollow, rising more in their external than internal Brim; by which their Articulations with the *Condylloid* Processes of the *Os occipitis* are firmer.—Under the external Edge of each of these oblique Processes, is the *Fossa*, or deep open Channel, in which the vertebral Arteries make the circular Turn, as they are about to enter the great *Foramen* of the occipital Bone, and where the tenth Pair of Nerves goes out.—In several Bodies, I have seen this *Fossa* covered with Bone.—The inferior oblique Processes extending from within outwards
and

and downwards, are large, concave, and circular. So that this *Vertebra*, contrary to the other six, receives the Bones with which it is articulated both above and below.

The transverse Processes here are not much hollowed or forked, but are longer and larger than those of any other *Vertebra colli*, for the Origin and Insertion of several Muscles; of which those that serve to move this *Vertebra* on the second have a considerable Lever to act with, because of the Distance of their Insertion from the *Axis* of Revolution.

The Hole for the *spinal Marrow* is larger in this than in any other *Vertebra*, not only on account of the *Marrow* being largest here, but also to prevent its being hurt by the Motions of this *Vertebra* on the second one. — This large Hole, and the long transverse Processes, make this the broadest *Vertebra* of the Neck.

The *Condyles* of the *Os occipitis* move forwards and backwards in the superior oblique Processes of this *Vertebra*, by means of their double *Arthrodia*, which makes what I called the third Species of *Ginglimus*; but very little Motion can here be allowed to either Side; and there must be still less of a circular Motion, which the *Head* obtains principally by the Circumvolution of the *Atlas* on the second *Vertebra*.

In new-born Children this *Vertebra* has only the two lateral Pieces ossified; the

Arch, which it has at its Fore-part instead of a Body, being cartilaginous.

The second *Vertebra colli* is called *Dentata*, from the Tooth-like Process on the upper Part of its Body. Some Authors call it *Epistrophe*, but improperly, since this Designation is only applicable to the first, which moves on this as on an Axis.

The Body of this *Vertebra* is somewhat of a pyramidal Figure, being large, and produced downwards, especially at its Fore-side, to enter into a Hollow of the *Vertebra* below; while the upper Part has a square Process with a small Point standing out from it. This it is that is imagined to resemble a Tooth *, and has given Name to the *Vertebra*.—The Side of this Process, which plays in the Hollow of the anterior Arch of the first *Vertebra*, is convex, smooth, and covered with a Cartilage; and it is of the same Form behind, for moving on the Ligament which is extended transversely from one rough Protuberance of the first *Vertebra* to the other, and is cartilaginous in the Middle, where this Tooth-like Process plays on it.—A Ligament likewise goes out in an oblique transverse Direction, from each Side of the *Processus dentatus*, to be fixed at its other End to the first *Vertebra*, and to the occipital Bone; and another Ligament rises up from the Point of the Process to the *Os occipitis*.

The superior oblique Processes of this *Vertebra dentata* are large, circular, very nearly

* Conoides, Pyrenoides, Odontoides.

nearly in an horizontal Position; and slightly convex, to be adapted to the inferior oblique Processes of the first *Vertebra*.—A moveable Cartilage is said by some Authors to be interposed between these oblique Processes of the first and second *Vertebra*; but I could never find it.—The inferior oblique Processes of this *Vertebra dentata* answer exactly to the Description given of those common to all the cervical *Vertebrae*.

The transverse Processes of the *Vertebra dentata* are short, very little hollowed at their upper Part, and not forked at their Ends; and the Canals through which the cervical Arteries pass, are reflected outwards about the middle Substance of each Process; so that the Course of these Vessels may be directed towards the transverse Processes of the first *Vertebra*.—Had this Curvature of the Arteries been made in a Part so moveable as the Neck is, while they were not defended by a Bone, and fixed to that Bone, scarce a Motion could have been performed without the utmost Hazard of Compression, and a Stop put to the Course of the Liquids, with all its Train of bad Consequences. Hence we observe this same Mechanism several times made use of, when there is any Occasion for a sudden Curvature of a large Artery. This is the third remarkable Instance of it we have seen. The first was the Passage of the *Carotides* through the *Ossa temporum*; and the second was that lately described in the vertebral Arteries,

Arteries turning round the oblique Processes of the first *Vertebra*, to come at the great *Foramen offis occipitis*.

The spinal Process of this *Vertebra dentata* is thick, strong, and short, to give sufficient Origin to the *Musculi recti majores*, and *obliqui inferiores*, and to prevent the Contusion of these Muscles in pulling the Head back.

This second *Vertebra* consists, at the Birth, of four bony Pieces: For, besides the three which I already mentioned as common to all the *Vertebrae*, the Tooth-like Process of this Bone is begun at this Time to be ossified in its Middle, and is joined as an Appendix to the Body of the Bone.—Lest this Appendix be bended or displaced, Nurses ought to keep the Heads of new-born Children from falling too far backwards, by *Stay-bands*, or some such Means, till the Muscles attain Strength sufficient to prevent that dangerous Motion.

When we are acquainted with the Structure and Articulations of the first and second *Vertebrae*, and know exactly the Strength and Connexion of their Ligaments, there is no Difficulty in understanding the Motions that are performed upon or by the first; though this Subject was formerly Matter of hot Dispute among some of the greatest Anatomists (a). It is none of my Purpose at present to enter into a Detail of the Reasons advanced by either Party; but to explain the Fact, as any one may see it, who

(a) See *Eustach. de motu Capitis*.

who will remove the Muscles, which, in a recent Subject, hinder the View of these two Joints, and then will turn the Head into all the different Positions it is capable of. The Head may then be seen to move forwards and backwards on the first *Vertebra*, as was already said, while the *Atlas* performs the *Circumgyratio* upon the second *Vertebra*; the inferior oblique Processes of the first *Vertebra* shuffling easily in a circular Way on the superior oblique Processes of the second, and its Body or anterior Arch having a Rotation on the Tooth-like Process, by which the perpendicular Ligament that is sent from the Point of the Tooth-like Process to the occipital Bone is twisted, while the lateral Ligaments that fix the *Processus dentatus* to the Sides of the first *Vertebra*, and to the *Os occipitis*, are very differently affected; for the one upon the Side towards which the Face is turned by the *Circumgyratio*, is much shortened and lax, while the opposite one is stretched and made tense, and, yielding at last no more, prevents the Head from turning any further round on this *Axis*. So that these lateral Ligaments are the proper *Moderators* of the *Circumgyratio* of the Head here, which must be larger or smaller, as these Ligaments are weaker or stronger, longer or shorter, and more or less capable of being stretched.— Besides this Revolution on this *Axis*, the first *Vertebra* can move a small Way to either Side; but is prevented from moving backwards and forwards, by its anterior Arch,

Arch, and by the cross Ligament, which are both closely applied to the Tooth-like Procefs. Motion forwards here would have been of very bad Consequence, as it would have brought the Beginning of the *Medulla spinalis* upon the Point of the Tooth-like Procefs.

The rotatory Motion of the Head is of great Use to us on many Accounts, by allowing us so quickly to apply our Organs of Sense to Objects: And the *Axis* of Rotation was altogether proper to be at this Place; for if it had been at a greater Distance from the Head, the Weight of the Head, if it had at any time been removed from a perpendicular Bearing to the small very moveable Joint, and thereby had acquired a long Lever, would have broke the Ligaments at every Turn inconsiderately performed; or these Ligaments must have been formed much stronger than could have been connected to such small Bones. Neither could this circular Motion be performed on the first *Vertebra* without Danger, because the immoveable Part of the *Medulla oblongata* is so near, as, at each large Turn, the Beginning of the *Medulla spinalis* would have been in danger of being twisted, and of suffering by the Compression this would have made on its tender Fibrils.

It is necessary to observe, that the *lateral* or *moderator* Ligaments confine so much the Motion of the first *Vertebra* upon the second, that, though this Joint may serve us on several Occasions; yet we are often obliged
to

to turn our Faces farther round, than could be done by this Joint alone, without the greatest danger of twisting the spinal Marrow too much, and also of luxating the oblique Processes; therefore, in large Turns of this kind, the Rotation is assisted by all the *Vertebræ* of the Neck and Loins; and if this is not sufficient, we employ most of the Joints of the lower Extremities.—This Combination of a great many Joints towards the Performance of one Motion, is also to be observed in several other Parts of the Body; notwithstanding that such Motions are generally said to be performed by some single Joint only.

The third *Vertebra* of the Neck is by some called *Axis*; but this Name is applied to it with much less Reason than to the second.—This third, and the three below, have nothing particular in their Structure; but all their Parts come under the general Description formerly given, each of them being larger as they descend.

The seventh * *Vertebra* of the Neck is near to the Form of those of the Back, having the Upper and Lower Surfaces of its Body less hollow than the others:—The oblique Processes are more perpendicular;—neither spinal nor transverse Processes are forked.—This seventh, and the sixth *Vertebra* of the Neck, have the Hole in each of their transverse Processes more frequently divided by a small cross Bridge, that goes
between

* Atlas quibusdam, maxima, magna *Vertebra*, prominens.

between the cervical Vein and Artery, than any of the other *Vertebræ*.

The twelve *Dorsal* † may be distinguished from the other *Vertebræ* of the Spine by the following Marks.

Their Bodies are of a middle Size, betwixt those of the Neck and Loins; — they are more convex before than either of the other two Sorts; and flattened laterally by the Pressure of the Ribs, which are inserted into small Cavities formed in their Sides. This flattening on their Sides, which makes the Figure of these *Vertebræ* almost an half Oval, is of good Use; as it affords a firm Articulation to the Ribs, allows the *Trachea arteria* to divide at a smaller Angle, and the other large Vessels to run secure from the Action of the vital Organs. — These Bodies are more concave behind than any of the other two Classes. — Their upper and lower Surfaces are horizontal.

The Cartilages interposed between the Bodies of these *Vertebræ* are thinner than in any other of the *true Vertebrae*; and contribute to the Concavity of the Spine here at its Fore-part, by their being thinnest at their Fore-part.

The *oblique* Processes are placed almost perpendicular; the upper ones slanting but a little forwards, and the lower ones slanting as much backwards. — Neither they, nor the *oblique* Processes of the Bones of the Neck,

† Θώρακος, μεταρρίον, νῶτον, ὑποτραχήλιον, Antisterni, pectoris, tergi.

Neck, have as much Convexity or Concavity as is worth remarking.—— A small Roughness is observable at their Roots, where the Ligaments that surround their Articulations are inserted; —— between the oblique Processes of opposite Sides, several sharp Processes stand out from the upper and lower Parts of the Plates, which join to form the spinal Process; into these sharp Processes strong Ligaments are fixed, for connecting the *Vertebræ*.

The *transverse* Processes of the *dorsal Vertebra* are long, thicker at their Ends than in the Middle, and turned obliquely backwards; which may be owing to the Pressure of the Ribs, the Tubercles of which are inserted into a Depression near the End of these Processes.

The *Spinal* Processes are long, small-pointed, and sloping downwards and backwards; from their Upper and Back part a Ridge rises, which is received by a small Channel in the Fore-part of the Spinal Process immediately above, which is here connected to it by a Ligament.

The *Conduit* of the *Medulla spinalis* is here more circular, but, corresponding to the Size of that Cord, is smaller than in any of the other *Vertebræ*; and a larger Share of the Holes in the bony Bridges, for the Transmission of the Nerves, is formed in the *Vertebra* above, than in the one below.

The Connexion of the *dorsal Vertebra* to the Ribs, the Thinness of their Cartilages,

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the erect Situation of the oblique Processes, the Length, sloping, and Connexion of the Spinal Processes, all contribute to restrain these *Vertebræ* from much Motion, which might disturb the Actions of the Heart and Lungs; and, in consequence of the little Motion allowed here, the *intervertebral* Cartilages sooner shrivel, by becoming more solid: And therefore the first remarkable Curvature of the Spine observed, as People advance to old Age, is in the least stretched *Vertebræ* of the Back; or old People first become round-shouldered.

The Bodies of the four uppermost *dorsal* *Vertebræ* deviate from the Rule of the *Vertebræ* becoming larger as they descend; for the first of the four is the largest, and the other three below gradually become smaller, to allow the *Trachea* and large Vessels to divide at smaller Angles.

The two uppermost *Vertebræ* of the Back, instead of being very prominent forwards, are flattened by the Action of the *Musculi longi colli* and *recti majores*.

The proportional Size of the two little Depressions in the Body of each *Vertebra* for receiving the Heads of the Ribs, seems to vary in the following Manner: The Depression on the Upper Edge of each *Vertebra* decreases as far down as the fourth, and after that increases.

The transverse Processes are longer in each lower *Vertebra* to the seventh or eighth, with their smooth Surfaces, for the Tubercles of the Ribs, facing gradually more downwards:

downwards; but afterwards as they descend they become shorter, and the smooth Surfaces are directed more upwards.

The spinous Processes of the *Vertebræ* of the Back become gradually longer and more slanting from the first, as far down as the eighth or ninth *Vertebra*; from which they manifestly turn shorter and more erect.

The first * *Vertebra*, besides an oblong Hollow in its lower Edge, that assists in forming the Cavity, wherein the second Rib is received, has the whole Cavity for the Head of the first Rib formed in it.

The second has the Name of *Axillary* †, without any thing particular in its Structure.

The eleventh ‡ often has the whole Cavity for the eleventh Rib in its Body, and wants the smooth Surface on each transverse Process.

The twelfth || always receives the whole Head of the last Rib, and has no smooth Surface on its transverse Processes, which are very short.—The smooth Surfaces of its inferior oblique Processes face outwards as the *Lumbar* do.—And we may say, in general, that the upper *Vertebræ* of the Back lose gradually their Resemblance to those of the Neck, and the lower ones come nearer to the Figure of the *Lumbar*.

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The

* *Ασπία*, Gutturalis.

† *Μασχαλίστηρ*.

‡ *Ἀφίπτης*, in neutram partem inclinans.

|| *Διασώστηρ*, præcingens.

The Articulation of the *Vertebræ* of the Back with the Ribs, shall be more particularly considered after the Ribs are described. Only it may be proper now to remark, that the Ligaments which serve that Articulation, assist in connecting the *Vertebræ*.

The lowest Order of the *true Vertebrae* is the *Lumbar* *, which are five Bones, that may be distinguished from any others by these Marks: 1. Their Bodies, though of a circular Form at their Fore-part, are somewhat oblong from one Side to the other; which may be occasioned by the Pressure of the large Vessels, and of the *Viscera*. The *Epiphyses* on their Edges are larger, and therefore the upper and lower Surfaces of their Bodies are more concave, than in the *Vertebrae* of the Back. 2. The Cartilages between these *Vertebrae* are much the thickest of any, and render the Spine convex within the *Abdomen*, by their greatest Thickness being at their Fore-part. 3. The oblique Processes are strong and deep; those in opposite Sides being almost placed in parallel Planes, the superior, which are concave, facing inwards, and the convex inferior ones facing outwards: And therefore each of these *Vertebrae* receives the one above it, and is received by the one below; which is not so evident in the other two Classes already described. 4. Their transverse Processes are small, long, and almost erect, for allowing large Motion to each Bone, and sufficient Insertion to Muscles, and

* Οσφύος, ἱεῦος, ὥσπιν, Renum, Lumborum.

and for supporting and defending the internal Parts. 5. Betwixt the Roots of the superior oblique and transverse Processes, a small Protuberance may be observed, where some of the Muscles that raise the Trunk of the Body are inserted. 6. Their spinal Processes are strong, streight, and horizontal, with broad flat Sides, and a narrow Edge above and below; this last being depressed on each Side by Muscles. And at the Root of these Edges, we see rough Surfaces for fixing the Ligaments. 7. The Canal for the *Medulla spinalis*, which is divided here into a great Number of Cords, is rather larger in these Bones, than in the *Vertebræ* of the Back. 8. The Holes for the Passage of the Nerves are more equally formed out of both the contiguous *Vertebræ* than in the other Classes; the upper one furnishes however the larger Share of each Hole.

The thick Cartilages between these *lumbar Vertebræ*, their deep oblique Processes, and their erect spinal Processes, are all fit for allowing large Motion; though it is not so great as what is performed in the Neck; which appears from comparing the Arches which the Head describes when moving on the Neck, or the Loins only.

The *lumbar Vertebræ* as they descend, have their oblique Processes at a greater Distance from each other, and facing more backwards and forwards.

Both transverse and spinal Processes of the middlemost *Vertebra* of the Loins are

longest and thickest; in the *Vertebra* above and below they are less: So that these Processes of the first * and fifth † are the least, to prevent their striking on the Ribs or *Ossa Ilium*, or their bruising the Muscles in the Motions of the Spine.

The *Epiphyses* round the Edges of the Bodies of the *lumbar Vertebrae* are most raised in the two lowest, which consequently make them appear hollower in the Middle than the others are.

The Body of the fifth *Vertebra* is rather thinner than that of the fourth.—The spinal Process of this fifth is smaller, and the oblique Processes face more backwards and forwards than in any other *lumbar Vertebra*.

The *true Vertebrae* serve to give us an erect Posture; to allow sufficient and secure Motion to the Head, Neck, and Trunk of the Body; and to support and defend the *Viscera*, and other soft Parts.

After considering the Structure of the particular *Vertebrae*, and their mutual Connexion, we may observe a solicitous Care taken that they shall not be disjoined, but with great Difficulty; for either their Bodies enter so into each other, as to prevent their being displaced any way, as in the *Vertebrae* of the Neck; or these Bodies are prop'd on all Sides, as these of the *Back* are by the Ribs; or their Surfaces of Contact are so broad, and the Ligaments so strong

* *Nervi*, renalis.

† *Αρχαλιος*, fulciens.

strong and firmly connected, as to render the Separation almost impracticable, as in the *Loins*; while the Depth and Articulation of the oblique Processes are exactly proportioned to the Quantity of Motion, which the other Parts of the Bones allow, or the Muscles can perform: Yet, as these oblique Processes are small, and therefore not capable of so secure a Conjunction as the larger Bodies, they may sooner yield to a disjoining Force; but then their Dislocation is not of near so bad Consequence as the Separation of the Bodies would be: For, by the oblique Processes being dislocated, the Muscles, Ligaments, and *Medulla spinalis*, are indeed stretched; but the *Medulla spinalis* must be compressed, or entirely destroyed when the Body of the *Vertebra* is removed out of its Place.

The *FALSE VERTEBRÆ* compose the under Pyramid of the *Spine*. They are distinguished from the Bones already described justly enough by this Epithet of *false*; because, though each Bone into which they can be divided in young People, resembles the *true Vertebrae* in Figure; yet none of them contribute to the Motion of the Trunk of the Body; they being intimately united to each other in Adults, except at their lower Part, where they are moveable; whence they are commonly divided into two Bones, *Os sacrum*, and *Coccygis*.

OS SACRUM *, is so called, from being offered in Sacrifice by the Ancients, or rather because of its Largeness in respect of the other *Vertebræ*.—This Bone is of an irregular triangular Shape, broad above, narrow below, convex behind, for the advantageous Origin of the Muscles that move the *Spine* and Thigh backwards; and concave before, for enlarging the Cavity of the *Pelvis*.—Four transverse Lines of a Colour different from the rest of the Bones which are seen on its Fore-part, are the Marks of Division of the five different Bones of which it consists in young Persons.

The Fore-part of the *Os sacrum*, analogous to the Bodies of the *true Vertebræ*, is smooth and flat, to allow a larger Space for the contained *Viscera*, without any Danger of hurting them; or this flat Figure may be owing to the equal Pressure of these *Viscera*, particularly of the last Gut. — The back Part of it is almost straight, without so large a Cavity as the *Vertebræ* have; because the spinal Marrow, now separated into the *Cauda equina*, is small. — The Bridges between the Bodies and Processes of this Bone, are much thicker, and in proportion shorter, than in the former Class of Bones. — The Strength of these cross Bridges is very remarkable in the three upper Bones, and is well proportioned to the incumbent Weight of the Trunk

* Ἱερὸν, σπονδύλος μεγάλς Hippocrat. ὑποσπονδύλον, Oribas. Πλατύ, Latum, Os clunium, Clavium.

Trunk of the Body, which these Bridges sustain in a transverse, consequently an unfavourable, Situation, when the Body is erect.

There are only two oblique Processes of the *Os sacrum*; one standing out on each Side from the upper Part of the first Bone. — Their plain erect Surfaces face backwards, and receive the inferior oblique Processes of the last *Vertebra* of the Loins, to which each of these Processes is connected by a strong Ligament, which rises from a scabrous Cavity round their Roots, where mucilaginous Glands are also lodged. — Instead of the other oblique Processes of this Bone, four rough Tubercles are to be seen on each Side of its Surface behind, from which the *Musculus sacer* has its Origin.

The transverse Processes here are all grown together into one large strong oblong Process on each Side; which, so far as it answers to the first three Bones, is very thick, and divided into two irregular Cavities, by a long perpendicular Ridge. — The foremost of the two Cavities has commonly a thin cartilaginous Skin covering it in the recent Subject, and is adapted to the unequal Protuberance of the *Os Ilium*, and a strong Ligament connects the Circumference of these Surfaces of the two Bones. — The Cavity behind is divided by a transverse Ridge into two, where strong ligamentous Strings that go from this Bone to the *Os Ilium*, with a cellular

lar Substance containing *Mucus*, are lodged.

The transverse Processes of the two last Bones of the *Os sacrum* are much smaller than the former. — At their Back-part near their Edge, a Knob and oblong flat Surface give rise to two strong Ligaments which are extended to the *Os Ischium*; and are therefore called *sacrosciatic*.

The spinal Processes of the three uppermost Bones of the *Os sacrum* appear short, sharp, and almost erect, while the two lower ones are open behind; and sometimes a little Knob is to be seen on the fourth, though generally it is bifurcated, without the two Legs meeting into a *Spine*; in which Condition also the first is often to be seen; and sometimes none of them meet, but leave a *Sinus*, or rather *Fossa*, instead of a Canal (*a*). — The *Musculus latissimus* and *longissimus Dorfi*, *Sacro-lumbalis*, and *Glutæus maximus*, have Part of their Origins from these spinal Processes.

The Canal between the Bodies and Processes of this Bone, for the *Cauda equina*, is triangular; and becomes smaller as it descends, as the *Cauda* also does. — Below the third Bone, this Passage is no more a compleat bony Canal, but is open behind; and is only there defended by a strong ligamentous Membrane stretched over it, which, with the Muscles that cover it, and are very prominent on each Side, is a sufficient

(*a*) *Verheyen*, Anat Tract. 5. cap. 9.

ent Defence for the Bundle of Nerves within.

At the Root of each oblique Process of this Bone, the Notch is conspicuous by which, and such another in the last *Vertebra* of the Loins, a Passage is left for the twenty fourth spinal Nerve; and, in viewing the *Os sacrum*, either before or behind, four large Holes appear in each Side, in much the same Height, as where the Marks of the Union of its several Bones remain. Some of the largest Nerves of the Body pass through the anterior Holes; and superficial Grooves running outwards from them in different Directions, shew the Course of these Nerves.—From the Intervals of these Grooves, the *Pyrisformis* Muscle chiefly rises.—The Holes in the back Part of the Bone are covered by Membranes which allow small Nerves to pass through them.—The two uppermost of these Holes, especially on the Fore-side, are the largest; and as the Bone descends, the Holes turn smaller. Sometimes a Notch is only formed at the lower Part in each Side of this Bone; and in other Subjects there is a Hole common to it and the *Os Coccygis*, through which the twenty ninth Pair of spinal Nerves passes; and frequently a bony Bridge is formed on the back Part of each Side by a Process sent up from the back Part of the *Os Coccygis*, and joined to the little Knobs which the last Bone of the *Os sacrum* has instead of a spinal Process. Under this Bridge, or *Jugum*, the twenty ninth Pair

Pair of spinal Nerves runs in its Course to the common Holes just now described.

The upper Part of the Body of the first Bone resembles the *Vertebræ* of the Loins; but the small fifth Bone is oblong transversely, and hollow in the Middle of its lower Surface.

The Substance of the *Os sacrum* is very spongy, without any considerable solid external Plates, and is lighter proportionally to its Bulk than any other Bone in the Body; but is secured from Injuries by the thick Muscles that cover it behind, and by the strong ligamentous Membranes that closely adhere to it. — As this is one of the most remarkable Instances of this Sort of Defence afforded a soft weak Bone, we may make this general Observation, That, where-ever we meet with such a Bone, one or other, or both these Defences are made use of; the first to ward off any Injury, and the second to keep the Substance of the Bone from yielding too easily.

This Bone is articulated above to the last *Vertebra* of the Loins, in the Manner that the *Lumbar Vertebrae* are joined; and therefore the same Motions may be performed here. — The Articulation of the lower Part of the *Os sacrum* to the *Os Coccygis* seems well enough adapted for allowing considerable Motion to this last Bone, was it not much confined by Ligaments. — Laterally the *Os sacrum* is joined to the *Ossa Ilium*, by an immoveable *Synchondrosis*, or what almost deserves the
Name

Name of a Suture ; for the cartilaginous Crust on the Surface of the Bones is very thin, and both their Surfaces are so scabrous and unequal, as to be indented into each other ; which makes such a strong Connexion, that great Force is required to separate them, after all the Muscles and Ligaments are cut. — Frequently the two Bones grow together in old Subjects.

The Uses of the *Os sacrum* are, to serve as the common Base and Support of the Trunk of the Body, to guard the Nerves proceeding from the End of the spinal Marrow, to defend the back Part of the *Pelvis*, and to afford sufficient Origin to the Muscles which move the Trunk and Thigh.

The Bones that compose the *Os sacrum* of Infants, have their Bodies separated from each other by a thick Cartilage ; and, in the same Manner as the *true Vertebrae*, each of them consists of a Body and two lateral Plates, connected together by Cartilages ; the Ends of the Plates seldom being contiguous behind.

OS COCCYGIS †, or *Rump-bone*, is that triangular Chain of Bones depending from the *Os sacrum* ; each Bone becoming smaller as they descend, till the last ends almost in a Point. The *Os Coccygis* is convex behind, and concave before ; from which crooked pyramidal Figure which was thought

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(†) ὀπίσθον, ὀπίς, Caudæ os, Spondylium, Os Cuculi.

to resemble a Cuckow's Beak, it has got its Name.

This Bone consists of four Pieces in People of middle Age: — In Children, very near the whole of it is Cartilage: In old Subjects, all the Bones are united, and become frequently one continued Bone with the *Os sacrum*.

The highest of the four Bones is the largest, with Shoulders extended farther to each Side than the End of the *Os sacrum*; which Enlargement should, in my Opinion, serve as a distinguishing Mark to fix the Limits of either Bone; and therefore should take away all Dispute about reckoning the Number of Bones, of which one or other of these two Parts of the *false Vertebrae* is composed; which Dispute must still be kept up, so long as the numbering five or six Bones in the *Os sacrum* depends upon the uncertain Accident of this broad-shouldered little Bone being united to, or separated from it. — The upper Surface of this Bone is a little hollow. — From the Back of that bulbous Part called its Shoulders, a Process often rises up on each Side, to join with the bifurcated Spine of the fourth and fifth Bones of the *Os sacrum*, to form the bony Bridge mentioned in the Description of the *Os sacrum*. — Sometimes these Shoulders are joined to the Sides of the fifth Bone of the *Os sacrum*, to form the Hole in each Side common to these two Bones, for the Passage of the twenty ninth Pair of spinal Nerves. — Immediately below

low the Shoulders of the *Os Coccygis*, a Notch may be remarked in each Side, where the thirtieth Pair of the spinal Nerves passes.—The lower End of this Bone is formed into a small Head, which very often is hollow in the Middle.

The three lower Bones gradually become smaller; and are very spongy; but are strengthened by a strong Ligament which covers and connects them.—Their Ends, by which they are articulated, are formed in the same Manner as those of the first Bone are.

Between each of these four Bones of young Subjects, a Cartilage is interposed; therefore their Articulation is analogous to that of the Bodies of the *Vertebræ* of the Neck: For, as has been above remarked, the lower End of the *Os sacrum*, and of each of the three superior Bones of the *Os Coccygis* has a small Depression in the Middle; and the upper Part of all the Bones of the *Os Coccygis* is a little concave, and consequently the interposed Cartilages are thickest in the Middle, to fill up both Cavities; by which they connect the Bones more firmly.—When the Cartilages ossify, the upper End of each Bone is formed into a Cavity, exactly adapted to the protuberant lower End of the Bone immediately above.—From this sort of Articulation, it is evident, that, unless when these Bones grow together, all of them are capable of Motion; of which the first and second, especially this last, enjoys the largest Share.

The lower End of the fourth Bone terminates in a rough Point, to which a Cartilage is appended.

To the Sides of these Bones of the *Os Coccygis*, the *Coccygæi* Muscles (*a*), and Part of the *Levatores Ani*, and of the *Glutæi maximi*, are fixed.

The Substance of these Bones is very spongy, and in Children cartilaginous; there being only a Part of the first Bone ossified in a new-born Infant.—Since therefore the *Intestinum rectum* of Children is not so firmly supported as it is in *Adults*, they are more subject to a *Procidentia Ani* than old People (*b*).

From the Description of this Bone, we see how little it resembles the *Vertebræ*, since it seldom has Processes, never has any Cavity for the *Medulla spinalis*, nor Holes for the Passage of Nerves.—Its Connexion hinders it to be moved to either Side; and its Motion backwards and forwards is much confined: Yet, as its Ligaments can be stretched by a considerable Force, it is a great Advantage in the Excretion of the *Fæces alvinæ*, and much more in Child-bearing, that this Bone should remain moveable; and the right Management of it, in delivering Women, may be of great Benefit to them (*c*).—The Mobility

(*a*) Douglas, Myograph. chap. 40:—Eustach. Tab. 36, No. 45. 20.

(*b*) Spigel. de humani corp. fabric. lib. 2. cap. 22.—Paaw, de Ossib. pars 2. cap. 3.

(*c*) Paaw, ibid.—Deventer. Operat. Chirug. cap. 27.

ility of the *Os Coccygis* diminishing as People advance in Age, especially when its Ligaments and Cartilages have not been kept flexible by being stretched, is probably one Reason why the Women, who are old Maids before they marry, have generally hard Labour in Child-bed.

The *Os Coccygis* serves to sustain the *Intestinum rectum*; and, in order to perform this Office more effectually, it is made to turn with a Curve forwards, by which also the Bone itself, as well as the Muscles and Teguments, is preserved from any Injury, when we sit with our Body reclined back.

The second Part of the Trunk of the Skeleton, the *PELVIS*, is the cylindrical Cavity at the lower Part of the *Abdomen*, formed by the *Os sacrum*, *Os Coccygis*, and *Ossa innominata*; which last fall now therefore in Course to be examined.

Though the Name of *OSSA INNOMINATA* * contributes nothing to the Knowledge of their Situation, Structure, or Office; yet they have been so long and universally known by it, that there is no Occasion for changing it.—They are two large broad Bones, which form the Fore-part and Sides of the *Pelvis*, and the lower Part of the Sides of the *Abdomen*.—In Children each of these Bones is evidently divided into three; which are afterwards so intimately united, that scarce the least Mark of their former Separation remains: This notwithstanding,

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standing,

* *Σακίων, προσρῦστος*, *Sacro conjuncta*.

standing, they are described as consisting each of three Bones, to wit, the *Os Ilium*, *Ischiûm*, and *Pubis*; which I shall first describe separately, and then shall consider what is common to any two of them, or to all the three.

OS ILIUM *, or *Haunch-bone*, is situated highest of the three, and reaches as far down as one Third of the great Cavity, into which the Head of the Thigh-bone is received.

The external Side of this Bone is unequally convex, and is called its *Dorsum*;—the internal concave Surface is by some (but improperly) named its *Costa*.—The semicircular Edge at the highest Part of this Bone, which is tipped with a Cartilage in the recent Subject, is named the *Spine*, into which the external, or descending oblique Muscle of the *Abdomen*, is inserted; and from it the internal ascending oblique and the transverse Muscles of the Belly, with the *Glutæus maximus*, *Quadratus lumborum*, and *latissimus Dorsi*, have their Origin. Some (a) are of Opinion, that it is only the tendinous Crust of all these Muscles, and not a Cartilage, as commonly alledged, that covers this bony Edge. — The Ends of the Spine are more prominent than the Surface of the Bone below them; therefore are reckoned Processes. — From the
anterior

* *Δαγόνων, κενίων*, Scaphium, lumbare, clunium, clavium, anchas.

(a) *Winflow*, Exposition Anatomique du corps humain, Traité des Os frais, § 96.

anterior spinal Process, the *Sartorius* and *Fascialis* Muscles have their Rise, and the outer End of the doubled Tendon of the external oblique Muscle of the *Abdomen*, commonly called *Fallopian's* or *Poupart's* Ligament, is fixed to it. — The Inside of the posterior spinal Process, and of Part of the Spine forward from that, is made flat and rough where the *Sacro-lumbalis* and *longissimus Dorsi* rise; and to its outside Ligaments, extended to the *Os sacrum* and transverse Processes of the fifth and fourth *Vertebra* of the Loins, are fixed (a). — Below the anterior spinal Process another Protuberance stands out, which, by its Situation, may be distinguished from the former, by adding the Epithet of *inferior*, where the *Musculus rectus Tibiæ* has its Origin (b). — Betwixt these two anterior Processes the Bone is hollowed, where the Beginning of the *Sartorius* Muscle is lodged. — Below the posterior spinal Process, a second Protuberance of the Edge of this Bone is in like Manner observable, which is closely applied to the *Os sacrum*. — Under this last Process a considerable large Niche is observable in the *Os Ilium*; between the Sides of which and the strong Ligament that is stretched over from the *Os sacrum* to the sharp-pointed Process of the *Os Ischiûm* of the recent Subject, a large Hole is formed, through which the
Muscul-

(a) *Weitbrecht*. Syndesmolog. Sect. 4. § 39. 40. 46. 47.

(b) *Baker*, Curs. Osteolog. demonstr. 3.

Muscul-pyriformis, the great sciatic Nerve, and the posterior crural Vessels pass, and are protected from any Compression.

The external broad Side or *Dorsum* of the *Os Ilium* is a little hollow towards the Fore-part; farther back it is as much raised; then is considerably concave; and, lastly, it is convex. These Inequalities are occasioned by the Actions of the Muscles that are situated on this Surface.—From behind the uppermost of the two anterior spinal Processes, in such Bones as are strongly marked by the Muscles, a semi-circular Ridge is extended to the hollow Passage of the sciatic Nerve. Between the Spine and this Ridge the *Glutæus medius* takes its Rise. Immediately from above the lowest of the anterior spinal Processes, a second Ridge is stretched to the Niche. Between this and the former Ridge, the *Glutæus minimus* has its Origin.——On the Outside of the superior spinal Processes, the *Dorsum* of the *Os Ilium* is flat and rough, where Part of the *Musculus Glutæus maximus* and *pyriformis* rises.—The lowest Part of this Bone is the thickest, and is formed into a large Cavity with high Brims, to assist in composing the great *Acetabulum*; which shall be considered, after all the three Bones that constitute the *Os innominatum* are described.

The internal Surface of the *Os Ilium* is concave in its broadest Fore-part, where the internal Iliac Muscle has its Origin, and some Share of the *Intestinum Ilium* and

Colon

Colon is lodged.—From this large Hollow a small Sinuosity is continued obliquely forwards, at the Inside of the anterior inferior spinal Process, where Part of the *Psoas* and *Iliacus* Muscles, with the crural Vessels and Nerves, pass. — The large Concavity is bounded below by a sharp Ridge, which runs from behind forwards; and, being continued with such another Ridge of the *Os Pubis*, forms a Line of Partition between the *Abdomen* and *Pelvis*.—Into this Ridge the broad Tendon of the *Psoas parvus* is inserted.

All the internal Surface of the *Os Ilium*, behind this Ridge, is very unequal: for the upper Part is flat, but spongy, where the *Sacro-lumbalis* and *longissimus Dorsi* rise.—Lower down there is a transverse Ridge, from which Ligaments go out to the *Os sacrum*.—Immediately below this Ridge the rough unequal Cavities and Prominences are placed, which are exactly adapted to those described on the Side of the *Os sacrum*.—In the same Manner the upper Part of this rough Surface is porous, for the firmer Adhesion of the ligamentous cellular Substance; while the lower Part is more solid, and covered with a thin cartilaginous Skin, for its immoveable Articulation with the *Os sacrum*.—From all the Circumferences of this large unequal Surface Ligaments are extended to the *Os sacrum*, to secure more firmly the Conjunction of these Bones.

The

The Passages of the medullary Vessels are very conspicuous, both in the *Dorsum* and *Costa* of many *Ossa Ilium*; but in others they are inconsiderable.

The posterior and lower Parts of these Bones are thick; but they are generally exceeding thin and compact at their Middle, where they are exposed to the Actions of the *Musculi glutæi* and *Iliacus internus*, and to the Pressure of the Bowels contained in the Belly.—The Substance of the *Ossa Ilium* is mostly cellular, except a thin external Table.

In a ripe Child the Spine of the *Os Ilium* is cartilaginous, and is afterwards joined to the Bone in Form of an *Epiphyse*.—The large lower End of this Bone is not completely ossified.

OS ISCHIIUM *, or *Hip-bone*, is of a middle Bulk between the two other Parts of the *Os innominatum*, is situated lowest of the three, and is of a very irregular Figure.—Its Extent might be marked by an horizontal Line drawn near through the Middle of the *Acetabulum*; for the upper bulbous Part of this Bone forms some less than the lower Half of that great Cavity, and the small Leg of it rises to much the same Height on the other Side of the great Hole common to this Bone and the *Os Pubis*.

From the upper thick Part of this *Os Ischiûm* a sharp Process, called by some *spinous*, stands out backwards, from which chiefly the *Musculus coccygæus* and *superior Gemellus*,

* *Coxæ, coxendicis, pisis.*

Gemellus, and Part of the *Levator Ani*, rise; and the anterior *Sacro-sciatic* Ligament is fixed to it.—Between the upper Part of this Ligament and the Bones, the *pyriform* Muscle, the posterior crural Vessels, and the Sciatic Nerve, pass out of the *Pelvis*.—Immediately below this Process, a Sinuosity is formed for the Tendon of the *Musculus obturator internus*.—In a recent Subject, this Part of the Bone, which serves as a Pulley on which the *Obturator* Muscle plays, is covered with a ligamentous Cartilage, that, by two or three small Ridges, points out the Interstices of the Fibres in the Tendon of this Muscle.—The outer Surface of the Bone at the Root of this spinous Process is made hollow by the *Pyriformis* or *Iliacus externus* Muscle.

Below the Sinuosity for the *Obturator* Muscle, is the great Knob or *Tuberosity*, covered with Cartilage or Tendon (a).—Into the back Part of its Edge the posterior *Sacro-sciatic* Ligament is fixed; between which, and the anterior one, and Sinuosity above described, a Passage is left for the *Obturator internus* Muscle. — The upper thick smooth Part of the *Tuber*, called by some its *Dorsum*, has two oblique Impressions on it. The inner one gives Origin to the long Head of the *Biceps flexor Tibiæ* and *seminervosus* Muscles, and the *Semimembranosus* rises from the exterior one which reaches higher and nearer the *Acetabulum* than the other.—The lower thinner more scabrous

(a) *Winslow*, *Exposit. Anat. des Os frais*, § 96.

scabrous Part of the Knob which bends forwards, is also marked with two flat Surfaces, whereof the internal is what we lean upon in sitting, and the external gives Rise to the largest Head of the *Triceps adductor femoris*. — Between the external Margin of the Tuberosity and the great Hole of the *Os innominatum*, frequently there is an obtuse Ridge extended down from the *Acetabulum*, which gives Origin to the *Quadratus femoris*. — The upper End of the *Tuber* gives Rise to the *Musculus gemellus inferior*, and the external or inferior *Sacro-sciatic* Ligament is fixed to its internal Edge. — As the *Tuber* advances forwards, it becomes smaller, and is rough, for the Origin of the *Musculus transversalis* and *Erector Penis*. — The small Leg of it, which mounts upwards to join the *Os Pubis*, is rough and prominent at its Edge, where the two lower Heads of the *Triceps* or *Quadriceps adductor femoris* take their Rise.

The upper and back Part of the *Os Ischiūm* is broad and thick; but its lower and fore Part is narrower and thinner. — Its Substance is of the Structure common to broad Bones.

The *Os Iliūm* and *Pubis* of the same Side, are the only Bones which are joined to the *Os Ischiūm*.

The Part of the *Os Ischiūm* which forms the *Acetabulum*, the spinous Process, the great *Tuber*, and the recurved Leg, are all cartilaginous at Birth. — The *Tuber* becomes

comes an Epiphyse before this Bone is fully formed.

The *OS PUBIS* *, or *Share-bone*, is the least of the three Parts of the *Os innominatum*, and is placed at the upper Fore-part of it.—The thick largest Part of this Bone is employed in forming the *Acetabulum*; from which becoming much smaller, it is stretched inwards to its Fellow of the other Side, where again it grows larger, and sends a small Branch downwards to join the End of the small Leg of the *Os Ischi m.*—The upper Fore-part of each *Os Pubis* is tuberos and rough where the *Musculus rectus* and *pyramidalis* are inserted.—From this a Ridge is extended along the upper Edge of the Bone, in a continued Line with such another of the *Os Ilium*, which divides the *Abdomen* and *Pelvis*. The Ligament of *Fallopian* is fixed to the internal End of this Ridge, and the smooth Hollow below it is made by the *Psoas* and *Iliacus internus* Muscles passing with the anterior crural Vessels and Nerves behind the Ligament.—Some way below the former Ridge, another is extended from the tuberos Part of the *Os Pubis* downwards, and outwards towards the *Acetabulum*; between these two Ridges the Bone is hollow and smooth, for lodging the Head of the *Pectineus* Muscle.—Immediately below, where the lower Ridge is to take the Turn downwards, a winding Niche is made, which is comprehended in the great *Foramen* of a Skele-

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ton,

* *ἰσχυρὸς*, Pectinis, penis, pudibundum, fenestratum.

ton, but is formed into a Hole by a subtended Ligament in the recent Subject, for the Passage of the posterial crural Nerve, an Artery, and a Vein.—The internal End of the *Os Pubis* is rough and unequal, for the firmer Adhesion of the thick ligamentous Cartilage that connects it to its Fellow of the other Side :—The Process which goes down from that to the *Os Ischiûm* is broad and rough before, where the *Gracilis* and upper Heads of the *Triceps*, or rather *Quadriceps adductor femoris*, have their Origin.

The Substance of the *Os Pubis* is the same as of other broad Bones.

Only a Part of the large End of this Bone is ossified ; and the whole Leg is cartilaginous in a Child born at the full Time.

Betwixt the *Os Ischiûm* and *Pubis* a very large irregular *Foramen* is left, which, from its Resemblance to a Door or Shield, has been called *Thyroides*. This Hole is all, except the Nitch for the posterior crural Nerve, filled up in a recent Subject with a strong ligamentous Membrane, that adheres very firmly to its Circumference. From this Membrane chiefly the two *Obturatores*, external and internal, take their Rise.—The great Design of this *Foramen*, besides rendering the Bone lighter, is to allow a strong enough Origin to the *obturator* Muscles, and sufficient Space for lodging their Bellies, that there may be no Danger of disturbing the Functions of the contained *Viscera* of the *Pelvis* by the Actions of the internal,
nor

nor of the external being bruised by the Thigh-bone, especially by its lesser *Trochanter*, in the Motions of the Thigh inwards: Both which Inconveniencies must have happened, had the *Ossa innominata* been compleat here, and of sufficient Thickness and Strength to serve as the fixed Point of these Muscles.

In the external Surface of the *Ossa innominata*, very near the Outside of the great *Foramen*, a large deep Cavity is formed by all the three Bones conjunctly: For the *Os Pubis* constitutes about one Fifth; the *Os Ilium* makes something less than two Fifths, and the *Os Ischium* as much more than two Fifths. The Brims of this Cavity are very high, and are still much more enlarged by the ligamentous Cartilage, with which they are tipped in a recent Subject. From this Form of the Cavity it has been called *Acetabulum*; and, for a distinguishing Character, the Name of the Bone that constitutes the largest Share of it is added; therefore *Acetabulum ossis Ischii* * is the Name this Cavity commonly bears.—Round the Base of the *Supercilia* the Bone is rough and unequal, where the *capsular* Ligament of the Articulation is fixed.—The Brims at the Upper and Back part of the *Acetabulum* are much larger and higher than any where else; which is very necessary, to prevent the Head of the *Femur* from slipping out of its Cavity at this Place, where the whole Weight of the Body bears upon it, and consequently

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would

* *Coxæ, coxendicis.*

would otherwise be constantly in danger of thrusting it out.—As these Brims are extended downwards and forwards, they become less; and at their internal lower Part a Breach is made in them. From the one Side of which Breach to the other, a Ligament is placed in the recent Subject; under which a large Hole is left, which contains a fatty cellular Substance and Vessels. The Reason of which Appearance has afforded Matter of Debate. To me it seems evidently contrived for allowing a larger Motion to the Thigh inwards: For if the bony Brims had been here continued, the Neck of the *Femur* must have struck upon them when the Thighs were brought across each other; which, in a large strong Motion this Way, would have endangered the Neck of the one Bone, or Brim of the other. Then the Vessels which are distributed to the Joint may safely enter at the Sinuosity in the Bottom of the Breach; which being however larger than is necessary for that Purpose, allows the large mucaginous Gland of the Joint to escape below the Ligament, when the Head of the Thigh-bone is in hazard of pressing too much upon it in the Motions of the Thigh outwards (a)—Besides this Difference in the Height of the Brims, the *Acetabulum* is otherwise unequal: For the lower internal Part of it is depressed below the cartilaginous Surface of the Upper-part, and is not covered with Cartilage; into its Upper-part, where it is deepest,

(a) *Petit, Memoires de l'Acad. des Sciences, 1722.*

est, and of a semilunar Form, the Ligament of the Thigh-bone, which is commonly, though improperly, called the *round* one, is inserted; while in its more superficial lower Part the large mucilaginous Gland of this Joint is lodged. The largest Share of this separate Depression is formed in the *Os Ischium*.

From what has been said of the Condition of the three Bones composing this *Aacetabulum* in new-born Children, it must be evident, that a considerable Part of this Cavity is cartilaginous in them.

The *Ossa innominata* are joined at their Back-part to each Side of the *Os sacrum* by a sort of Suture, with a very thin interveening Cartilage, which serves as so much Glue to cement these Bones together; and strong Ligaments go from the Circumference of this unequal Surface, to connect them more firmly. The *Ossa innominata* are connected together at their Fore-part by the thick firm Cartilage interposed between the two *Ossa Pubis*.— These Bones can therefore have no Motion in a natural State, except what is common to the Trunk of the Body or to the *Os sacrum*. But it has been disputed, whether or not they loosen so much from each other, and from the *Os sacrum* in Child-birth, by the Flow of *Mucus* to the *Pelvis*, and by the Throws of the Labour, as that the *Ossa Pubis* recede from each other, and thereby allow the Passage between the Bones to be enlarged.—

ged.—Several Observations (a) shew that this Relaxation sometimes happens: But those who had frequently Opportunities of dissecting the Bodies of Women who died immediately after being delivered of Children, teach us to beware of regarding this as the common Effect of Child-birth; for they found such a Relaxation in very few of the Bodies which they examined (b). — I have frequently applied my Fingers to the Teguments covering the Conjunction of the *Ossa Pubis* in very laborious Births, but never could be sensible of any Separation or Motion of these Bones; nor could I observe it in the Bodies of some Women who died soon after they were delivered of Children, when I applied all my Strength to draw the *Ossa Pubis* asunder, and to make them shuffle backwards or forwards.

Considering what great Weight is supported in our erect Posture, by the Articulation of the *Ossa innominata* with the *Os sacrum*, there is great Reason to think, that if the conglutinated Surfaces of these Bones were once separated, the Ligaments would be violently stretched, if not torn; from whence many Disorders would arise (c).—I have sometimes suspected a Relaxation of the Parts connecting the *Ossa innominata*

(a) *Bauhin*. Theat. Anat. lib. 1. cap. 49.—*Spigel*. Arat. lib. 2. cap. 24.—*Rislan*. Anthropogr. lib. 6. cap. 12.—*Diemerbroeck*, Anat. lib. 9. cap. 16.

(b) *Hildan*. Epist. Cent. obs. 46.—*Dionis*, Sixieme Demonstr. des Os.—*Morgagn*. Advers. 3. Animad. 15.

(c) *Ludov*. in Ephem. German. Dec. 1. ann. 3. obs. 254.

innominata and *Sacrum*, in Women of a delicate tender Make, who, after hard Labour, complained of Pain, Weakness, and of a sort of jirking Motion in this Place, which I could not be in the least sensible of with my Fingers. For several Months they could neither sit nor stand without Pain; and they had a Weakness here much longer, complaining that they thought they were always sinking down between the Haunch-bones.

Each *Os innominatum* affords a Socket (the *Acetabulum*) for the Thigh-bones to move in, and sometimes we turn the Trunk of the Body on the Heads of the Thigh-Bones.—This Articulation is to be more fully described after the *Ossa femoris* are examined.

The *Pelvis* then has a large Open above where it is continued with the *Abdomen*, is strongly fenced by Bones on the Sides, Back, and Fore-part, and appears with a wide Opening below, in the Skeleton; but, in the recent Subject, a considerable Part of the Opening is filled by the *Sacro-sciatic* Ligaments, *Quadrigemini* and *Coccygæi* Muscles, which support and protect the contained Parts better than Bones could have done; so that Space is only left at the lowest Part of it, for the large Excretories, the *Vesica urinaria*, *Intestinum rectum*, and, in Females, the *Uterus*, to discharge themselves.

The

The *THORAX* †, or *Chest*, which is the only Part of the Trunk of the Body which we have not yet described, reaches from below the Neck to the Belly; and, by means of the Bones that guard it, is formed into a large Cavity: The Figure of which is somewhat conoidal; but its upper smaller End is not finished, being left open for the Passage of the Wind-pipe, Gullet, and large Blood-vessels; and its lower Part, or Base, has no Bones, and is shorter before than behind; so that, to carry on our Comparison, it appears like an oblique Section of the Conoid. Besides which we ought also to remark, that the lower Part of this Cavity is narrower than some Way above (*a*); and that the Middle of its Back-part is considerably diminished by the Bones standing forwards into it.

The Bones which form the *Thorax* are the twelve dorsal *Vertebræ* behind, the Ribs on the Sides, and the *Sternum* before.

The *Vertebræ* have already been described as Part of the Spine; and therefore are now to be passed.

The *RIBS*, or *Costæ* †, (as if they were *Custodes*, or Guards, to these principal Organs of the animal Machine, the Heart and Lungs), are the long crooked Bones placed at the Side of the Chest, in an oblique Direction downwards in respect of the Back-bone.—Their Number is generally twelve on each

† *Pectus, cassum.*

(*a*) *Albin. de Ossib. § 169.*

† *Πλευραι, περισίρνα, σπάσαι.*

each Side ; though frequently eleven or thirteen have been found.—I never saw fewer or more than the ordinary Number, but in the Skeleton of a Boy, about eight Years old, now in my Possession ; the fourth and fifth Ribs of the left Side are grown together at their Roots for near an Inch, and, afterwards dividing, have the same Appearance as the Ribs of the opposite Side, which are naturally formed.

The Ribs are all convex externally, and concave internally ; where they are also made smooth by the Action of the contained Parts, which, on this account, are in no Danger of being hurt by them.—The Ends of the Ribs next the *Vertebræ* are rounder than they are after these Bones have advanced forwards, when they become flatter and broader, and have an upper and lower Edge, each of which is made rough by the Action of the *intercostal* Muscles inserted into them. These Muscles, being all of nearly equal Force, and equally stretched in the Interstices of the Ribs, prevent the broken Ends of these Bones in a Fracture from being removed far out their natural Place, to interrupt the Motion of the vital Organs.—The upper Edge of the Ribs is more obtuse and rounder than the lower, which is depressed on its internal Side by a long *Fossa*, for lodging the intercostal Vessels and Nerves ; on each Side of which there is a Ridge to which the intercostal Muscles are fixed. The Channel is not observable however
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at either End of the Ribs; for, at the posterior or Root, the Vessels have not yet reached the Ribs; and, at the Fore-end, they are split away into Branches, to serve the Parts between the Ribs: Which plainly teaches Surgeons one Reason of the greater Safety of performing the Operation of the *Empyema* towards the Sides of the *Thorax*, than either near the Back or the Breast.

At the posterior End * of each *Rib*, a little Head is formed, which is divided by a middle Ridge into two plain or hollow Surfaces; the lowest of which is the broadest and deepest. The two Plains are joined to the Bodies of two different *Vertebræ*, and the Ridge forces itself into the intervening Cartilages.—A little Way from this Head, we find on the external Surface a small Cavity, where mucilaginous Glands are lodged; and round the Head, the Bone appears spongy, where the capsular Ligament of the Articulation is fixed.—Immediately beyond this a flattened Tubercle rises, with a small Cavity at, and Roughness about its Root, for the Articulation of the Rib with the transverse Process of the lowest of the two *Vertebræ*, with the Bodies of which the Head of the Rib is joined.—Advancing further on this external Surface, we observe in most of the Ribs another smaller Tubercle, into which Ligaments which connect the Ribs to the transverse Processes of the *Vertebræ* and Portions of the *longissimus Dorsi* are inserted.—

Beyond

* *Κεφάλιον*. Remulus.

Beyond this the Ribs are made flat by the *Sacro-lumbalis* Muscle, which is inserted into the Part of this flat Surface farthest from the Spine, where each Rib makes a considerable Curve, called by some its *Angle*.——

Then the Rib begins to turn broad, and continues so to its anterior End *, which is hollow and spungy, for the Reception of, and firm Coalition with the Cartilage that runs thence to be inserted into the *Sternum*, or to be joined with some other Cartilages.

—In Adults generally the Cavity at this End of the Ribs is smooth and polished on its Surface; by which the Articulation of the Cartilage with it has the Appearance of being designed for Motion; but it has none.

The Substance of the Ribs is spungy, cellular, and only covered with a very thin external lamellated Surface, which increases in Thickness and Strength as it approaches the *Vertebræ*.

To the Fore-end of each Rib a long broad and strong Cartilage is fixed, and reaches thence to the *Sternum*, or is joined to the Cartilage of the next Rib. This Course, however, is not in a straight Line with the Rib; for generally the Cartilages make a considerable Curve, the concave Part of which is upwards; therefore, at their Insertion into the *Sternum*, they make an obtuse Angle above, and an acute one below.——These Cartilages are of such a Length, as never to allow the Ribs to come to a right Angle with

* Πλάτη, Palmula.

with the Spine; but they keep them situated so obliquely, as to make an Angle very considerably obtuse above, till a Force exceeding the Elasticity of the Cartilages is applied.—These Cartilages, as all others, are firmer and harder internally, than they are on their external Surface; and sometimes, in old People, all their middle Substance becomes bony, while a thin cartilaginous *Lamella* appears externally (a). The Ossification however begins much oftener at the external Surface.—The greatest alternate Motions of the Cartilages being made at their great Curvature, that Part remains frequently cartilaginous, after all the rest is ossified (b).

The Ribs then are articulated at each End, of which the one behind is doubly joined to the *Vertebræ*; for the Head is received into the Cavities of two Bodies of the *Vertebræ*, by what I called the second Species of *Ginglimus*; and the larger Tubercle is articulated to the transverse Process of of the lower *Vertebra*, by what is commonly called *Arthrodia*, which I comprehended under the *Enarthrosis*: And if we were to consider conjunctly both these Articulations of any Rib with the *Vertebræ*, it would come under the third Species of *Ginglimus*.—When one examines this double Articulation, he must immediately see, that no other Motion can here be allowed, than upwards and downwards; since the transverse

(a) *Vesal. Lib. 1. cap. 19.*

(b) *Havers, Osteolog. nov. Disc. 5. p. 289.*

verse Process hinders the Rib to be thrust back; the Resistance on the other Side of the *Sternum*, prevents the Rib's coming forward; and each of the two Joints with the other Parts attached, oppose its turning round. But then it is likewise as evident, that even the Motion upwards and downwards, can be but small in any one Rib at the Articulation itself. But as the Ribs advance forwards, the Distance from their Center of Motion increasing, the Motion must be larger; and it would be very conspicuous at their anterior Ends, were not they resisted there by the Cartilages, which yield so little, that the principal Motion is performed by the middle Part of the Ribs, which turns outwards and upwards, and occasions the Twist remarkable in the long Ribs at the Place near their Fore-end where they are most resisted (*a*).

Hitherto I have laid down the Structure and Connexion which most of the Ribs enjoy, as belonging to all of them; but must now consider the Specialities wherein any of them differ from the general Description given, or from each other.

In viewing the Ribs from above downwards, their Figure is still straighter; the uppermost being the most crooked of any. — Their Obliquity in respect of the Spine increases as they descend; so that though their Distance from each other is very little different at their Back-part, yet at their Fore-ends the Distances between the lower

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(*a*) *Winflow*. Memoires de l'Acad. des Sciences, 1720.

ones must increase.—In consequence too of this increased Obliquity of the lower Ribs, each of their Cartilages makes a greater Curve in its Progress from the Rib towards the *Sternum*; and the Tubercles, that are articulated to the transverse Processes of the *Vertebræ*, have their smooth Surface gradually facing more upwards.—The Ribs becoming thus more oblique, while the *Sternum* advances forward in its Descent, makes the Distance between the *Sternum* and the anterior End of the lower Ribs greater than between the *Sternum* and the Ribs above; consequently the Cartilages of those Ribs that are joined to the Breast-bone are longer in the lower than in the higher ones.—These Cartilages are placed nearer to each other as the Ribs descend, which occasions the Curvature of the Cartilages to be greater.

The Length of the Ribs increases from the first or uppermost Rib, as far down as the seventh; and from that to the twelfth, as gradually diminishes.—The superior of the two plain, or rather hollow Surfaces, by which the Ribs are articulated to the Bodies of the *Vertebræ*, gradually increases from the first to the fourth Rib, and is diminished after that in each lower Rib.—The Distance of their Angles from the Heads always increases as they descend to the ninth, because of the greater Breadth of the *Sacrolumbalis* Muscle (a).

The Ribs are commonly divided into *true* and *false*.

The

(a) *Winflow*, Exposition Anatomique des Os Secs, § 643.

The *true* * *Costæ* are the seven upper ones of each Side, whose Cartilages are all gradually longer as the Ribs descend, and are joined to the Breast-bone; so that being pressed constantly between two Bones, they are flatted at both Ends, and are thicker, harder, and more liable to ossify, than the other Cartilages, that are not subject to so much Pressure. These Ribs include the Heart and Lungs; and therefore are the proper or true *Custodes* of Life.

The five inferior Ribs of each Side are the *false* or *BASTARD* †, whose Cartilages do not reach to the *Sternum*; and therefore, wanting the Resistance at their Fore-part, they are there pointed; and, on this account, having less Pressure, their Substance is softer.—The Cartilages of these *false Ribs* are shorter as the Ribs descend.—To all these five Ribs the circular Edge of the *Diaphragm* is connected; and its Fibres, instead of being stretched immediately transversely, and so running perpendicular to the Ribs, are pressed so as to be often, especially in Expiration, parallel to the Plane in which the Ribs ly: Nay, one may judge by the Attachments which these Fibres have so frequently to the Sides of the *Thorax*, a considerable Way above where their Extremities are inserted into the Ribs, and by the Situation of the *Viscera*, always

U 2

to

* Γνήσαι, Germanæ, legitimæ.

† Μαλθάναι, χονδροῦς, ἀκανθαί, κλίεις, ρόαι, Adulterinæ, spurie, illegitimæ.

to be observed in a dead Subject laid supine, that there is constantly a large Concavity formed on each Side by the *Diaphragm* within these bastard Ribs, in which the Stomach, Liver, Spleen, &c. are contained; which, being only reckoned among the *Viscera naturalia*, have occasioned the Name of *Bastard Custodes* to these Bones.

Hence in simple Fractures of the false Ribs, without a Fever, the Stomach ought to be kept moderately filled with Food, lest the pendulous Ribs falling inwards, should thereby increase the Pain, Cough, &c. (a).
 —Hence likewise we may learn how to judge better of the Seat of several Diseases, and to do the Operation of the *Empyema*, and some others, with more Safety than we can do, if we follow the common Directions.

The eight upper Ribs were formerly (b) classed into Pairs, with particular Names to each two, to wit, the *crooked*, the *solid*, the *pectoral*, the *twisted*: But these Names are of so little Use, that they are now generally neglected.

The *first* Rib of each Side is so situated, that the flat Sides are above and below, while one Edge is placed inwards, and the other outwards, or nearly so; therefor sufficient Space is left above it for the Subclavian Vessels and Muscle; and the
 broad

(a) Hippocrat. de Articulo. § 51.---Pars. Lib. 15. cap. 11.

(b) Laurent. Hist. Anat. lib. 2. cap. 19. --- Pars, de Ossib. Part. 3. cap. 2.

broad concave Surface is opposed to the Lungs: But then, in consequence of this Situation, the Channel for the intercostal Vessels is not to be found, and the Edges are differently formed from all the other, except the second; the lower one being rounded, and the other sharp.—The Head of this Rib is not divided into two plain Surfaces by a middle Ridge, because it is only articulated with the first *Vertebra* of the *Thorax*.—Its Cartilage is ossified in Adults, and is united to the *Sternum* at right Angles. — Frequently this first Rib has a Ridge rising near the Middle of its posterior Edge, where one of the Heads of the *Scalenus* Muscle rises. — Farther forward it is flatted, or sometimes depressed by the Clavicle.

The fifth, sixth, and seventh, or rather the sixth, seventh, eighth, and sometimes fifth, sixth, seventh, eighth, ninth Ribs, have their Cartilages at least contiguous; and frequently they are joined to each other by cross Cartilages; and most commonly the Cartilages of the eighth, ninth, tenth, are connected to the former, and to each other, by firm Ligaments.

The *eleventh*, and sometimes the *tenth* Rib, has no Tubercle for its Articulation with the transverse Process of the *Vertebra*, to which it is only loosely fixed by Ligament.—The *Fossa* in its lower Edge, is not so deep as in the upper Ribs, because the Vessels run more towards the Interstice between the Ribs.—Its Fore-end is smaller

ler than its Body, and its short small Cartilage is but loosely connected to the Cartilage of the Rib above.

The *twelfth* Rib is the shortest and straightest.—Its Head is only articulated with the last *Vertebra* of the *Thorax*; therefore is not divided into two Surfaces.—This Rib is not joined to the transverse Process of the *Vertebra*, and therefore has no Tubercle, being often pulled necessarily inwards by the Diaphragm, which an Articulation with the transverse Process would not have allowed.—The *Fossa* is not found at its under Edge, because the Vessels run below it.—The Fore-part of this Rib is smaller than its Middle, and has only a very small-pointed Cartilage fixed to it.—To its whole internal Side the Diaphragm is connected.

The Motion and Uses of the Ribs shall be more particularly treated of, after the Description of the *Sternum*.

The Heads and Tubercles of the Ribs of a new-born Child have but little Cartilage on them; part of it sometimes, however, becomes afterwards a thin Epiphyse.—The Bodies of the Ribs incroach gradually after Birth upon the Cartilages; so that the latter are proportionally shorter, when compared to the Ribs, in Adults, than in Children.

Here I cannot help remarking the wise Providence of our Creator, in preserving us from perishing as soon as we come into the World. The End of the Bones of the Limbs

Limbs remain in a cartilaginous State after Birth, and are many Years before they are entirely united to the main Body of their several Bones; whereas the Condyles of the occipital Bone, and of the Lower Jaw, are true original Processes, and ossified before Birth, and the Heads and Tubercles of the Ribs are nearly in the same Condition; and therefore the Weight of the large Head is firmly supported; the Actions of Sucking, Swallowing, Respiration, &c. which are indispensably necessary for us as soon as we come into the World, are performed without Danger of separating the Parts of the Bones that are most pressed on in these Motions: Whereas, had these Processes of the Head, Jaw, and Ribs, been Epiphyses at Birth, Children must have been exposed to imminent Danger of dying by such a Separation; the immediate Consequences of which would be the Compression of the Beginning of the *Medulla spinalis*, or want of Food, or a Stop put to Respiration.

The *STERNUM* *, or *Breast-bone*, is the broad flat Bone, or Pile of Bones, at the Fore-part of the *Thorax*. — The Number of Bones, which this should be divided into, has occasioned Debates among Anatomists, who have considered it in Subjects of different Ages. — In Adults of a middle Age, it is composed of three Bones, which easily separate after the Cartilages connecting them are destroyed. Frequently the two lower Bones are found intimately united; and very

* Στήθος, Os Pectoris, ensiforme, scutum cordis.

ry often in old People, the *Sternum* is a continued bony Substance from one End to the other; though we still observe two, sometimes three, transverse Lines on its Surface; which are Marks of the former Divisions.

When we consider the *Sternum* as one Bone, we find it broadest and thickest above, and becoming smaller as it descends. The internal Surface of this Bone is somewhat hollowed for enlarging the *Thorax*; but the Convexity on the external Surface is not so conspicuous, because the Sides are pressed outwards by the true Ribs; the round Heads of whose Cartilages are received into seven smooth Pits, formed in each Side of the *Sternum*, and are kept firm there by strong Ligaments, which on the external Surface have a particular radiated Texture (a).—Frequently the cartilaginous Fibres thrust themselves into the bony Substance of the *Sternum*, and are joined by a sort of Suture.——The Pits at the upper Part of the *Sternum*, are at the greatest Distance one from another, and, as they descend, are nearer; so that the two lowest are contiguous.

The Substance of the Breast-bone is cellular, with a very thin external Plate, especially on its internal Surface, where we may frequently observe a cartilaginous Crust spread over it (b). On both Surfaces, however, a strong ligamentous Membrane is closely braced; and the Cells of this Bone
are

(a) *Ruyfch*, Catalog: Rar. fig. 9.

(b) *Jac. Sylv.* in *Galen.* de Ossibus, cap. 12.

are so small, that a considerable Quantity of osseous Fibres must be employed in the Composition of it: Whence, with the Defence which the Muscles give it, and the moveable Support it has from the Cartilages, it is sufficiently secured from being broken; for it is strong by its Quantity of Bone; its Parts are kept together by Ligaments; and it yields enough to elude considerably the Violence offered (a).

So far may be said of this Bone in general; but the three Bones, of which, according to the common Accounts, it is composed in Adults, are each to be examined.

The *first*, all agree, is somewhat of the Figure of a Heart, as it is commonly painted; only it does not terminate in a sharp Point. — This is the uppermost thickest Part of the *Sternum*.

The upper Middle-part of this first Bone, where it is thickest, is hollowed, to make Place for the *Trachea arteria*; though this Cavity * is principally formed by the Bone being raised on each Side of it, partly by the Clavicles thrusting it inwards, and partly by the *Sterno-mastoidei* Muscles pulling it upwards. — On the Outside of each Tubercle, there is an oblong Cavity, that, in viewing it transversely from before backwards, appears a little convex: Into these *Glenæ* the Ends of the Clavicles are received. — Immediately below these, the Sides of this Bone begin to turn thinner; and in each

(a) *Senac.* in *Memoires de l'Acad. des Sciences*, 1724.

* *Ἐπαχὴ*, Jugulum, Furecula superior.

each a superficial Cavity or a rough Surface is to be seen, where the first Ribs are received or joined to the *Sternum*.—In the Side of the under End of this first Bone, the half of the Pit for the second Rib on each Side is formed.—The upper Part of the Surface behind is covered with a strong Ligament, which secures the Clavicles; and is afterwards to be more particularly taken notice of.

The second or middle Division of this Bone, is much longer, narrower, and thinner, than the first; but, excepting that it is a little narrower above than below, it is nearly equal all over in its Dimensions of Breadth or Thickness.—In the Sides of it are compleat Pits for the third, fourth, fifth, and sixth Ribs, and an half of the Pits for the second and seventh. The Lines, which are Marks of the former Division of this Bone, being extended from the Middle of the Pits of one Side to the Middle of the corresponding Pits of the other Side.—Near its Middle an unossified Part of the Bone is sometimes found, which, freed of the ligamentous Membrane or Cartilage that fills it, is described as an Hole; and in this Place, for the most part, we may observe a transverse Line, which has made Authors divide this Bone into two.—When the Cartilage between this and the first Bone is not ossified, a manifest Motion of this upon the first may be observed in Respiration, or in raising the *Sternum*, by pulling the Ribs upwards in a recent Subject.

The

The third Bone is much less than the other two, and has only one half of the Pit for the seventh Rib formed in it; wherefore it might be reckoned only an *Appendix* of the *Sternum*. — In young Subjects it is always cartilaginous, and is better known by the Name of *Cartilago xiphoides* or *ensiformis* †, than any other; though the Ancients often called the whole *Sternum*, *Ensiforme*, comparing the two first Bones to the handle, and this *Appendix* to the Blade of a Sword. — This third Bone is seldom of the same Figure, Magnitude, or Situation in any two Subjects; for sometimes it is a plain triangular Bone, with one of the Angles below, and perpendicular to the Middle of the upper Side, by which it is connected to the second Bone. — In other People the Point is turned to one Side, or obliquely forwards or backwards. — Frequently it is all nearly of an equal Breadth, and in several Subjects it is bifurcated; whence some Writers give it the Name of *Furcella* or *Furcula inferior*; or else it is unossified in the Middle. — In the greatest Number of Adults it is ossified, and tipped with a Cartilage; in some one half of it is cartilaginous, and in others it is all in a cartilaginous State. — Generally several oblique Ligaments fixed at one End to the Cartilages of the Ribs, and by the other to

† Clypealis, gladialis, mucronata, malum granatum, lectum stomachi, epiglottalis, cultralis, Medium Furculæ inferioris, scutiformis, ensiculata.

to the outer Surface of the *xiphoid* Bone, connect it firmly to those Cartilages (a).

So many different Ways this small Bone may be formed, without any Inconvenience: But then some of these Positions may be so directed, as to bring on a great Train of ill Consequences; particularly, when the lower End is ossified, and is too much turned outwards or inwards (b), or when the Conjunction of this *Appendix* with the second Bone is too weak (c).

The *Sternum* is joined by *Synchondrosis* to the seven upper Ribs, unless when the first coalesces with it in an intimate Union of Substance; and it is articulated with each of the *Clavicles* by a *Ginglimus* of the second kind.

The *Sternum* most frequently has four round small Bones, surrounded with Cartilage, in Children born at the full Time; the uppermost of these, which is the first Bone, being the largest.—Two or three other very small bony Points are likewise to be seen in several Children.—The Number of Bones increases for some Years, and then diminishes but uncertainly, till they are at last united into those above described of an Adult.

The Uses of this Bone are, to afford Origin and Insertion to several Muscles;
to

(a) *Weithrecht*, Synthesmolog. p. 121.

(b) *Rolfinc.* Dissert. Anat. lib. 2. cap. 41.—*Paaw*, de Ossib. part. 1. cap. 3. & part. 3. cap. 3.

(c) *Paaw*, Ibid.—*Borrigh.* Act. Hafn. vol. 5. obs. 79.—*Bonet.* Sepulchret. Anat. tom. 2. lib. 3. § 5. Append. ad obs. 8. & ibid. § 7. obs. 19.

to sustain the *Mediaſtinum*, to defend the vital Organs, the Heart and Lungs, at the Fore-part ; and, laſtly, by ſerving as a moveable *Fulcrum* of the Ribs, to aſſiſt conſiderably in Reſpiration : Which Action, ſo far as it depends on the Motion of the Bones, we are now at Liberty to explain.

When the Ribs that are connected by their Cartilages to the *Sternum*, or to the Cartilages of the true Ribs, are acted upon by the intercoſtal Muſcles, they muſt all be pulled from the oblique Poſition which their Cartilages kept them in, nearer to right Angles with the *Vertebræ* and *Sternum*, becauſe the firſt or uppermoſt Rib is by much the moſt fixed of any ; and the Cartilages making a great Reſiſtance to the raiſing their anterior Ends, their large arched middle Parts turn outwards as well as upwards.—The *Sternum*, preſſed ſtrongly on both Sides by the Cartilages of the Ribs, is pushed forwards, and that at its ſeveral Parts, in proportion to the Length and Motion of its Supporters, the Ribs ; that is, moſt at its lower End.—The *Sternum* and the Cartilages, thus raiſed forwards, muſt draw the *Diaphragm* connected to them ; conſequently ſo far ſtretch it, and bring it nearer to a Plane.—The Power that raiſes this Bone and the Cartilages, fixes them ſufficiently to make them reſiſt the Action of the *Diaphragm*, whoſe Fibres contract at the ſame time, and thruſt the *Viſcera* of the *Abdomen* downwards.—The arched Part of the Ribs being thus moved outwards, their anterior Ends and the *Sternum* being ad-

vanced forwards, and the Diaphragm being brought nearer to a plain Surface, instead of being greatly convex on each Side within each Cavity of the *Thorax*, it is evident how considerably the Cavity, of which the nine or ten upper Ribs are the Sides, must be widened, and made deeper and longer.—While this is doing in the upper Ribs, the lower ones, whose Cartilages are not joined to the *Sternum* or to other Cartilages, move very differently, though they conspire to the same Intention, the Enlargement of the *Thorax*: For having no fixed Point to which their anterior Ends are fastened, and the *Diaphragm* being inserted into them at the Place where it runs pretty streight upwards from its Origin at the *Vertebræ*, these Ribs are drawn downwards by this strong Muscle, and by the Muscles of the *Abdomen*, which, at this Time, are resisting the stretching Force of the Bowels; while the intercostal Muscles are pulling them in the contrary Direction, to wit, upwards: The Effect therefore of either of these Powers, which are Antagonists to each other, is very little, as to moving the Ribs either up or down; but the Muscles of the *Abdomen*, pushed at this Time outwards by the *Viscera*, carry these Ribs along with them.—Thus the *Thorax* is not only not allowed to be shortened, but is really widened at its lower Part, to assist in making sufficient Space for the due Distension of the Lungs.

As soon as the Action of these several Muscles ceases, the elastic Cartilages extending

tending themselves to their natural Situation, depress the upper Ribs, and the *Sternum* subsides; — the Diaphragm is thrust up by the *Viscera abdominalia*, and raises the lower Ribs with it; in which it is assisted by what Action their intercostal Muscles have; while the oblique and transverse Muscles of the Belly serve to draw these Ribs inwards at the same time. — By these Causes, the Cavity of the Breast is diminished in all its Dimensions.

Though the Motions above described of the Ribs and *Sternum*, especially of the latter Bone, are so small in the mild Respiration of an healthy Person, that we can scarce observe them; yet they are manifest whenever we designedly increase our Respiration, or are obliged to do it after Exercise, and in several Diseases.

Of the SUPERIOR EXTREMITIES.

Authors are much divided in their Opinions about the Number of Bones which each *superior Extremity* * should be said to consist of, some describing the *Clavicle* and *Scapula* as Part of it, others classing these two Bones with those of the *Thorax*: But since most Quadrupeds have no *Clavicles*, and the human *Thorax* can perform its Functions right when the *Scapula* is taken away (a), whereas it is im-

X 2.

possible

† Κῆλα, γῦα, ἐκρύαδες. Enata, adnata, explantata membra, artus.

(a) Philosoph. Transact. Num. 449. § 5.

possible for us to have the right Use of our Arms without these Bones; I must think that they belong to the *superior Extremities*; and therefore shall divide each of them into the *Shoulder, Arm, Fore-arm,* and *Hand*.

The *SHOULDER* consists of the *Clavicle* and *Scapula*.

CLAVICULA, or *Collar-bone* *, is the long crooked Bone, in Figure like an *Italic* f placed almost horizontally between the upper lateral Part of the *Sternum*, and what is commonly called the Top of the Shoulder, which, as a *Clavis* or Beam, it bears off from the Trunk of the Body.

The *Clavicle*, as well as other long round Bones, is larger at its two Ends, than in the Middle. The End next to the *Sternum* † is triangular: The Angle behind is considerably produced, to form a sharp Ridge, to which the transverse Ligament extended from one Clavicle to the other is fixed (b). — The Side opposite to this is somewhat rounded. — The Middle of this protuberant End, is as irregularly hollowed, as the Cavity in the *Sternum* for receiving it is raised; but, in a recent Subject, the irregular Concavities of both, are supplied by a moveable Cartilage, which
is

* Os jugulare, jugulum, furcula, ligula, clavis, humerus quibusdam.

† Παράσπαις.

(b) *Riolan*. Encherid. Anat. lib. vi. cap. 13. — *Winflow*, *Expos. Anat. des Os frais*, § 248. — *Weithrecht*. Act. Petropolit. tom. 4. p. 255. & *Synthesmolog.* Sect. 2. I. 3.

is much more closely connected every where by Ligaments to the Circumference of the Articulation, than those of the Lower Jaw are; but grows to the two Bones at both its internal and external End; its Substance at the internal End being soft, but very strong, and resembling the intervertebral Cartilages (a).

From this internal End, the *Clavicle*, for about two Fifths of its Length, is bended obliquely forwards and downwards. On the Upper and Fore part of this Curvature a small Ridge is seen, with a plain rough Surface before it; whence the *Musculus sterno-hyoideus* and *sterno-mastoideus* have in part their Origin. — Near the lower Angle a small plain Surface is often to be remarked, where the first Rib and this Bone are contiguous (b), and are connected by a firm Ligament (c). — From this a rough plain Surface is extended outwards, where the pectoral Muscle has Part of its Origin. — Behind, the Bone is made flat and rough by the Insertion of the larger Share of the Subclavian Muscle. — After the Clavicle begins to be bended backwards, it is round, but soon after becomes broad and thin; which Shape it retains to its external End. — Along the external Concavity, a rough Sinuosity runs, from which some Part of the Deltoid Muscle takes its Rise: — Opposite to this, on the convex Edge, a scabrous Ridge gives Insertion to a Share

X 3:

of

(a) *Weitbrecht*, Syndesmolog. Sect. 2. I. § 6.

(b) *Dionis*, Sixieme Demonst. des Os.

(c) *Weitbrecht*, Syndesmolog. Sect. 2. I. § 7.

of the *cucullaris* Muscle. The upper Surface of the Clavicle here is flat; but the lower is hollow, for lodging the Beginning of the *Musculus subclavius*, and towards its Back-part a Tubercle rises, to which, and a Roughness near it, the strong short thick Ligament connecting the Bone to the *coracoid* Process of the *Scapula* is fixed.

The external End * of this Bone is horizontally oblong, smooth, sloping at the posterior Side, and tipped in a recent Subject with a Cartilage, for its Articulation with the *Acromion scapulæ*.—Round this the Bone is spongy, for the firmer Connexion of the Ligaments.

The medullary Arteries, having their Direction obliquely outwards, enter the Clavicles by one or more small Passages in the Middle of their Back-part.

The Substance of this Bone is the same as of the other round long Bones.

It is joined to the *Sternum* by what I called the second Species of *Ginglimus*; there being Protuberances and Depressions of the two Bones that form this moveable Joint.—The Ligaments, which surround this Articulation to secure it, are so short and strong, that little Motion can be allowed any way; and the strong Ligament that is stretched across the upper *Furcula* of the *Sternum*, from the posterior prominent Angle of one Clavicle, to the same Place of the other Clavicle, serves to keep each of these Bones more firmly in their Place—By the Assistance

* *Extremis.*

ance, however, of the moveable intervening Cartilage, the Clavicle can, at this Joint, be raised or depressed, and moved backwards and forwards so much, as that the external End, which is at a great Distance from that Axis, enjoys very conspicuous Motions.—The Articulation of the exterior End of the Clavicle shall be considered after the Description of the *Scapula*.

The Clavicles of Infants are not deficient in any of their Parts; nor have they any Epiphyses at their Extremities joined afterwards to their Bodies, as most other such long Bones have, which preserves them from being bended too much, and from the Danger of any unossified Parts being separated by the Force which pulls the Arms forwards.

The Uses of the Clavicles are, to keep the *Scapulæ*, and consequently all the *superior Extremities*, from falling in and forward upon the *Thorax*; by which, as in most Quadrupeds, the Motions of the Arms would be much confined, and the Breast made too narrow.—The Clavicles likewise afford Origin to several Muscles, and a Defence to large Vessels.

SCAPULA, or *Shoulder-blade* *, is the triangular Bone situated on the Outside of the Ribs, with its longest Side, called its *Base*, towards the spinal Processes of the *Vertebræ*, and with the Angle at the upper Part of this Side about three Inches, and the

* Ὠμοπλάτος, ἑπινώτιον, Latitudo humeri, scoptulum vel scutulum opertum, spatula, ala, humerus, clypeus, scutum thoracis.

the lower Angle at a greater Distance from these Processes. — The Back-part of the *Scapula* has nothing but the thin Ends of the *Serratus anticus major* and *Subscapularis* Muscles between it and the Ribs: But as this Bone advances forwards, its Distance from the Ribs increases. — The upper or shortest Side, called the *superior Costa* of the *Scapula*, is nearly horizontal, and parallel with the second Rib. — The lower Side, which is named the *inferior Costa*, is extended obliquely from the third to the eighth Rib. — The inferior Angle is very acute; the lower one is near to a right Angle; and what is called the anterior, does not deserve the Name; for the two Sides do not meet to form an Angle. — The Body of this Bone is concave towards the Ribs, and convex behind, where it has the Name of *Dorsum* †. — Three Processes are generally reckoned to proceed from the *Scapula*. — The first is the large Spine that rises from its convex Surface behind, and divides it unequally. — The second Process stands out from the Fore-part of the upper Side; and, from its imaginary Resemblance to a Crow's Beak, is named *Coracoides* ‡. — The third Process is the whole thick bulbous Fore-part of the Bone.

After thus naming the several constituent Parts of the *Scapula*, the particular Description will be more easily understood.

The

† Κελεύριον.

‡ Anchoroides, sigmoides, digitalis, ancistroides.

The *Base*, which is tipped with Cartilage in a young Subject, is not all streight: For above the Spine, it runs obliquely forwards to the superior Angle; that here it might not be too protuberant backwards, and so bruise the Muscles and Teguments: Into the oblique Space the *Musculus patientiæ* is inserted.—At the Root of the Spine, on the Back-part of the Base, a triangular plain Surface is formed, by the Pressure of the lower Fibres of the *Trapezius*.—Below this the Edge of the *Scapula* is scabrous and rough, for the Insertion of the *Serratus major anticus* and *rhomboid* Muscles.

The Back-part of the inferior Angle is made smooth by the *latissimus Dorsi* passing over it. This Muscle also alters the Direction of the *inferior Costa* some way forwards from this Angle; and so far it is flatted behind by the Origin of the *Teres major*.—As the *inferior Costa* advances forward, it is of considerable Thickness, is slightly hollowed, and made smooth behind by the *Teres minor*, while it has a *Fossa* formed into it below by part of the *Subscapularis*; and between the two a Ridge with a small Depression appears, where the *longus extensor Cubiti* has its Origin.

The *superior Costa* is very thin; and near its Fore-part there is a semilunar Nitch, from one End of which to the other a Ligament is stretched; and sometimes the Bone is continued, to form one, or sometimes two, Holes, for the Passage of the scapular Blood-vessels and Nerves.—Immediately behind
this

this *Cavitas semilunata*, the *Musculus coraco-hyoideus* has its Rise. From the Nitch to the Termination of the *Fossa* for the *Teres minor*, the *Scapula* is narrower than any where else, and supports the third Process. This Part has the Name of *Cervix*.

The whole *Dorsum* of the *Scapula* is always said to be convex; but, by reason of the raised Edges that surround it, it is divided into two Cavities by the Spine, which is stretched from behind forwards, much nearer to the superior, than to the inferior *Costa*.—The *Cavitas supraspinata* is really concave where the *supraspinatus* Muscle is lodged; while the Surface of this Bone below the Spine, on which the *infraspinatus* Muscle is placed, is convex, except a *Fossa* that runs at the Side of the *inferior Costa*.

The internal or anterior Surface of this Bone is hollow, except in the Part above the Spine, which is convex.—The *subscapularis* Muscle is extended over this Surface, where it forms several Ridges and intermediate Depressions, commonly mistaken for Prints of the Ribs; they point out the Interstices of the Bundles of Fibres of which the *subscapularis* Muscle is composed (a).

The Spine * rises small at the Base of the *Scapula*, and becomes higher and broader as it advances forwards.—On the Sides it is unequally hollowed and crooked, by the Actions of the adjacent Muscles.—Its
Ridge

(a) Winslow, in Memoires de l'Acad. des Sciences, 1722.

* Ράχis, ὑπὲρ ἢ ὀμοπλάτων, Eminentia scapularum.

Ridge * is divided into two rough flat Surfaces: Into the upper one, the *Trapezius* Muscle is inserted; and the lower one has part of the *Deltoid* fixed to it.—The End of the Spine, called *Acromion* †, or Top of the Shoulder, is broad and flat, and is sometimes only joined to the Spine by a Cartilage.—The anterior Edge of the *Acromion* is flat, smooth, and covered with a Cartilage, for its Articulation with the external End of the Clavicle; and it is hollowed below, to allow a Passage to the *infra-* and *supra-spinati* Muscles, and free Motion to the *Oss. humeri*.

The *coracoid* ‡ Process is crooked, with its Point inclining forwards; so that a Hollow is left at the lower Side of its Root, for the Passage of the *infra-scapularis* Muscle.—The End of this Process is marked with three plain Surfaces. Into the internal, the *Serratus minor anticus* is inserted: From the external, one Head of the *Biceps flexor cubiti* rises; and from the lower one, the *Coracobrachialis* has its Origin.—At the Upper-part of the Root of this Process, immediately before the *Cavitas semilunaris*, a smooth Tubercle appears, where a Ligament from the *Clavicle* is fixed. From all the external Side of this coracoid *Apophyse*, a broad Ligament goes out, which becomes narrower where it is fixed to the *Acromion*.—

The

* Pterygium, crista.

† Ἐπώμης, ἀγκυροειδῆς, κορακοειδῆς, κατακλῆς. *Acromii os, summus armus, rostrum porcinum, processus digitalis.*

‡ Ἀγκυροειδῆς, σίγμοειδῆς, *Rostriformis.*

The sharp Pain, violent Inflammation, and tedious Cure of Contusions in this Part, are probably owing to these Tendons and Ligaments being hurt.

From the *Cervix scapulæ* the third Process is produced. The Fore-part of this is formed into a *Glenoid Cavity* †, which is of the Shape of the longitudinal Section of an Egg, being broad below, and narrow above. —Between the Brims of this Hollow, and the Fore-part of the Root of the Spine, a large Sinuosity is left, for the Transmission of the *supra- and infra-spinati* Muscles; and on the Upper-part of these Brims we may remark a smooth Surface, where the second Head of the *Biceps flexor cubiti* has its Origin. —The Root of the *Supercilia* is rough all round, for the firmer Adhesion of the capsular Ligament of the Articulation, and of the Cartilage which is placed on these Brims, where it is thick, but becomes very thin as it is continued towards the Middle of the Cavity, which it lines all over.

The medullary Vessels enter the *Scapula* near the Base of the Spine.

The Substance of the *Scapula* is, as in all other broad flat Bones, cellular, but of an unequal Thickness; for the Neck and third Process are thick and strong. The inferior *Costa*, Spine, and coracoid Process, are of a middle Thickness; and the Body is so pressed by the Muscles, as to become thin and diaphanous.

The

† Ὠμοκότυλις.

The *Scapula* and *Clavicle* are joined by plain Surfaces, tipped with Cartilage *; to which sort of Articulation I applied the technical Name *Arthrodia*, by which neither Bone is allowed any considerable Motion, being tightly tied down by the common capsular Ligament, and by a very strong one which proceeds from the coracoid Process; but divides into two before it is fixed into the *Clavicle*, with such a Direction, as either can allow this Bone to have a small Rotation, in which its posterior Edge turns more backwards, while the anterior one rises farther forwards; or it can yield to the Forepart of the *Scapula* moving downwards, while the Back-part of it is drawn upwards; in both which Cases the oblong smooth articulated Surfaces of the *Clavicle* and *Scapula* are not in the same Plane, but stand a little transversely, or across each other, and thereby preserve this Joint from Luxations, to which it would be subject, if either of the Bones was to move on the other perpendicularly up and down, without any Rotation.—Sometimes a moveable ligamentous Cartilage is found in this Joint; otherwhiles such a Cartilage is only interposed at the anterior Half of it; and in some old Subjects I have found a sesamoid Bone here (a).—The *Scapula* is connected by *Sysarcosis* to the Head, *Os hyoides*, *Vertebræ*, Ribs, and Arm-bone; and, by means of the Muscles, that have one End fastened to these Bones,

Y

and

* Acromion, κατακλῆς, Clausuræ.

(a) Jac. Sylv. Isagog. Anat. lib. 1. cap. 2.

and the other to the *Scapula*, it can be moved upwards, downwards, backwards or forwards; by the quick Succession of these Motions, its whole Body is carried in a Circle. But being also often moved, as upon an Axis perpendicular to its Plane, its Circumference turns in a Circle whose Center this Axis is (a). Whichever of these Motions it performs, it always carries the outer End of the Clavicle and the Arm along with it. — The *glenoid* Cavity of this Bone receives the *Os humeri* by *Enarthrosis*, of which more hereafter.

The Use of the *Scapula* is, to serve as a *Fulcrum* to the Arm; and, by altering its Position on different Occasions, to allow always the Head of the *Os humeri* a right situated Socket to move in; and thereby to assist and to enlarge greatly the Motions of the *superior Extremity*, and to afford the Muscles which rise from it more advantageous Actions, by altering their Directions to the Bone which they are to move. — This Bone also serves to defend the Back-part of the *Thorax*, and is often employed to sustain Weights, or to resist Forces, too great for the Arm to bear.

The Base, *Acromion*, coracoid Process, and Head of the *Scapula*, are all in a cartilaginous State at the Birth; and the three first are joined as *Epiphyses*; while the Head, with the *glenoid* Cavity, is not formed into a distinct separate Bone, but is gradually produced by the Ossification of the Body

(a) See Winslow Memoires de l'Acad. des Sciences, 1726.

Body of this Bone being continued forwards.

The *ARM*, has only one Bone, best known by the *Latin Name* of *Os humeri* †; which is long, round, and nearly straight.

The upper End of this Bone * is formed into a large round smooth Head, whose middle Point is not in a straight Line with the Axis of the Bone, but stands obliquely backwards from it.—The Extent of the Head is distinguished by a circular *Fossa* surrounding its Base, where this Head is united to the Bone, and from which the capsular Ligament of the Joint rises.—Below the Fore-part of its Base two Tubercles stand out: The smallest one, which is situated most to the Inside, has the Tendon of the *subscapularis* Muscle inserted into it. — The larger more external Protuberance is divided at its upper Part into three smooth plain Surfaces: Into the anterior of which, the *Musculus supraspinatus*; into the middle or largest, the *infraspinatus*; into the one behind, the *Teres minor*, is inserted.—Between these two Tubercles, exactly in the Fore-part of the Bone, a deep long *Fossa* is formed, for lodging the tendinous Head of the *Biceps flexor cubiti*; which, after passing, in a Manner peculiar to itself, through the Cavity of the Articulation, is tied down by a tendinous Sheath extended across the *Fossa*; in which, and in the neighbouring

Y 2 Tubercles,

† Ἀκροκομία, ὀλίγη, *Os brachii, armi, adjutorium, parvum brachium, canna brachii.*

* *Acrocolium.*

Tubercles, are several remarkable Holes, which are penetrated by the tendinous and ligamentous Fibres, and by Vessels. — On each Side of this *Fossa*, as it descends in the *Os humeri*, a rough Ridge, gently flatted in the Middle, runs from the Roots of the Tubercles. — The Tendon of the *pectoral* Muscle is fixed into the anterior of these Ridges, and the *latissimus Dorsi*, and *Teres major*, are inserted into the internal one. — A little behind the lower End of this last, another rough Ridge may be observed, where the *Coraco-brachialis* is inserted. — From the Back-part of the Root of the largest Tubercle, a Ridge also is continued, from which the *Brevis extensor cubiti* rises. — This Bone is flatted on the Inside, about its Middle, by the Belly of the *Biceps flexor cubiti*. — In the Middle of this plain Surface, the Entry of the medullary Artery is seen slanting obliquely downwards. — At the Fore-side of this Plane the Bone rises in a Sort of Ridge, which is rough, and often has a great many small Holes in it, where the Tendon of the strong *Deltoid* Muscle is inserted; on each Side of which the Bone is smooth and flat, where the *Brachæus internus* rises. The exterior of these two flat Surfaces is the largest; behind it a superficial spiral Channel, formed by the *Muscular* Nerve, and the Vessels that accompany it, runs from behind forwards and downwards. — The Body of the *Os humeri* is flatted behind by the Extensors of the Fore-arm.

Near

Near the lower End of this Bone, a large sharp Ridge is extended on its Out-side. from which the *Musculus supinator radii longus*, and the longest Head of the *Extensor carpi radialis*, rise.—Opposite to this, there is another small Ridge to which the *aponeurotic Tendon*, that gives Origin to the Fibres of the internal and external *Brachii* Muscles is fixed; and from a little Depression on the Fore-side of it, the *Pronator radii teres* rises.

The Body of the *Os humeri* becomes gradually broader towards the lower End, where it has several Processes; at the Roots of which, there is a Cavity before, and another behind *. The anterior is divided by a Ridge into two; the external, which is the least, receives the End of the *Radius*; and the internal receives the *Coronoid Process* of the *Ulna* in the Flexions of the Fore-arm, while the posterior deep triangular Cavity lodges the *Olecranon* in the Extensions of that Member.—The Bone betwixt these two Cavities is pressed so thin by the Processes of the *Ulna*, as to appear diaphanous in several Subjects.—The Sides of the posterior Cavity are stretched out into two Processes, one on each Side: These are called *Condyles*; from each of which a strong Ligament goes out to the Bones of the *Fore-arm*.—The external *Condyle*, which has an oblique Direction also forwards in respect of the internal, when the Arm is in the most nat-

* *Baglivi*.

tural Posture (a), is equally broad, and has an obtuse smooth Head rising from it forwards.—From the rough Part of the *Condyle*, the inferior Head of the *Bicornis*, the *Extensor digitorum communis*, *Extensor carpi ulnaris*, *Anconæus*, and some Part of the *Supinator radii brevis*, take their Rise; and on the smooth Head the upper End of the *Radius* plays.—Immediately on the the Outside of this, there is a Sinuosity made by the shorter Head of the *Bicornis* Muscle, upon which the Muscular Nerve is placed.—The internal *Condyle* is more pointed and protuberant than the external, to give Origin to some Part of the *Flexor carpi radialis*, *Pronator radii teres*, *Palmaris longus*, *Flexor digitorum sublimis*, and *Flexor carpi ulnaris*.—Between the two *Condyles*, is the *Trochlea*, or Pulley, which consists of two lateral Protuberances, and a middle Cavity that are smooth and covered with Cartilage.—When the Fore-arm is extended, the Tendon of the internal *Brachiiæus* Muscle is lodged in the Fore-part of the Cavity of this Pulley.—The external Protuberance, which is less than the other, has a sharp Edge behind; but forwards, this Ridge is obtuse, and only separated from the little Head, already described, by a small *Fossa*, in which the joined Edges of the *Ulna* and *Radius* move.—The internal Protuberance of the Pulley is largest and highest; and therefore in the Motions of the *Ulna* upon it, that Bone would

(a) *Winflow*, *Memoires de l'Acad. des Sciences*, 1722.

would be inclined outwards, was it not supported by the *Radius* on that Side.—Between this internal Protuberance and *Condyle*, a Sinuosity may be remarked, where the *ulnar Nerve* passes.

The Substance and the internal Structure of the *Os humeri* is the same, and disposed in the same Way, as in other long Bones.

The round Head at the upper End of this Bone is articulated by *Enarthrosis*, with the *Glenoid Cavity* of the *Scapula*; which being superficial, and having long Ligaments, allows the Arm a free and extensive Motion.—These Ligaments are however considerably strong: For, besides the common capsular one, the Tendons of the Muscles perform the Office, and have been described under the Name of *Ligaments*—Then the *Acromion* and *Coracoid Process*, with the strong broad Ligaments stretched betwixt them, secure the Articulation above, where the greatest and most frequent Force is applied to thrust the Head of the Bone out of its Place. It is true, that there is not near so strong a Defence at the lower Part of the Articulation; but in the ordinary Postures of the Arm, that is, so long as it is at an acute Angle with the Trunk of the Body, there cannot be any Force applied at this Place to occasion a Luxation, since the Joint is protected so well above.

The Motions which the Arm enjoys by this Articulation, are to every Side; and,
by

by the Succession of these different Motions; a Circle may be described. Besides which, the Bone performs a small Rotation round its own *Axis*. But though this can be performed with the round Head in all Positions; yet as these vary, the Effects upon the Body of the Bone are very different: For, if the Middle of the Head is the Center of Rotation, as it is when the Arm hangs down by the Side, the Body of the Bone is only moved forwards and backwards; because the *Axis* of Motion of the Head is nearly at right Angles with the Length of the Bone (a); whereas when the Arm is raised to right Angles with the Trunk of the Body, the Center of Motion, and the *Axis* of the Bone, come to be in the same streight Line; and therefore the Body of the *Os humeri* performs the same Motion with its Head.—Though the Motions of the Arm seem to be very extensive, yet the larger Share of them depends on the Motion of the *Scapula*. The lower End of the *Os humeri* is articulated with the Bones of the Fore-arm, and carries them with it in all its Motions, but serves as a Base on which they perform the Motions peculiar to themselves; as shall be described afterwards.

Both the Ends of this Bone are cartilaginous in a new-born Infant, and the large Head with the two Tubercles, and the *Trochlea* with the two *Candyles*, become *Epiphyses*

(a) *Hippocrat. de Articul. § 1.*

ses before they are united to the Body of the Bone.

The *FORE-ARM* * consists of two long Bones, the *Ulna* and *Radius*; whose Situation, in respect of each other, is oblique in the least straining or most natural Posture; that is, the *Ulna* is not directly behind, nor on the Outside of the *Radius*, but in a middle Situation between these two, and the *Radius* crosses it.—The Situation however of these two Bones, and of all the other Bones of the *superior Extremity* that are not yet described, is frequently altered; and therefore, to shun Repetitions, I desire it may be now remarked, that, in the remaining Account of the *superior Extremity*, I understand by the Term of *posterior*, that Part which is in the same Direction with the Back of the Hand; by *anterior*, that answering to the Palm; by *internal*, that on the same Side with the Thumb; by *external*, the Side nearest to the little Finger; supposing the Hand always to be in a middle Position between *Pronation* and *Supination*.

ULNA †, so named from its being used as a Measure, is the longest of the two Bones of the Fore-arm, and situated on the Outside of the *Radius*.

At the upper End of the *Ulna* are two Processes.—The posterior is the largest, and formed like a Hook, whose concave Surface moves upon the Pully of the *Os humeri*,

* Cubitus, πῆχυς, ὠλὴν, πυγᾶν, *Ulna*, *lacertus*.

† Cubitus, πῆχυς, προπύχιον, *Focile majus*. *Canna vel arundo major & inferior Brachii*.

humeri, and is called *Olecranon* †, or Top of the Cubit.—The convex Back-part of it is rough and scabrous, where the *Longus*, *Brevis*, and *Brachæus externus*, are inserted. The *Olecranon* makes it unnecessary that the Tendons of the extensor Muscles should pass over the End of the *Os humeri*; which would have been of ill Consequence in the great Flexions of this Joint, or when any considerable external Force is applied to this Part (a).—The anterior Process is not so large, nor does it reach so high, as the one behind; but it is sharper at its End, and therefore is named *Coronoid*.—Between these two Processes, a large semicircular or *sigmoid* Concavity is left; the Surface of which, on each Side of a middle Rising, is slanting, and exactly adapted to the Pulley of the Bone of the Arm.—Across the middle of it, there is a small Sinuosity for lodging mucilaginous Glands; where, as well as in a small Hollow on the internal Side of it, the Cartilage that lines the rest of its Surface is wanting.—Round the Brims of this Concavity the Bone is rough, where the capsular Ligament of the Joint is implanted.—Immediately below the *Olecranon* on the Back-part of the *Ulna*, a flat triangular spongy Surface appears, on which we commonly lean.—At the internal Side of this, there is a larger hollow Surface, where the *Musculus Anconæus* is lodged; and the Ridge

at

† *Αγκών*, Gibber, Cubitus, Additamentum necatum.
 (a) *Winflow*. Exposition Anatomique du Corps humain, Traité des Os secs, § 979.

at the Inside of this gives Rise to the *Musculus supinator radii brevis*.—Between the Top of this Ridge and the *coronoid* Process is the semilunated smooth Cavity, lined with Cartilage, in which, and a Ligament extended from the one to the other End of this Cavity, the round Head of the *Radius* plays.—Immediately below it a rough Hollow gives Lodging to mucaginous Glands.—Below the Root of the *coronoid* Process, this Bone is scabrous and unequal, where the *Brachæus internus* is inserted.—On the Outside of that we observe a smooth Concavity, where the Beginning of the *Flexor digitorum profundus* sprouts out.

The Body of the *Ulna* is triangular.—The internal Angle is very sharp, where the Ligament that connects the two Bones is fixed;—the Sides, which makes this Angle, are flat and rough, by the Action and Adhesion of so many Muscles as are situated here.—At the Distance of one Third of the Length of the *Ulna* from the Top, in its Fore-part, the Passage of the medullary Vessels is to be remarked slanting upwards.—The external Side of this Bone is smooth, somewhat convex, and the Angles at each Edge of it are blunted, by the Pressure of the Muscles equally disposed about them.

As this Bone descends, it becomes gradually smaller; so that its lower End terminates in a little Head, standing on a small Neck.——Towards the fore, but outer Part of which last, an oblique Ridge runs, that gives Rise to the *Pronator radii quadratus*.

dratus. — The Head is round, smooth, and covered with a Cartilage on its internal Side, to be received into the semilunar Cavity of the *Radius*; while a *styloid* Process † rises from its Outside, to which is fixed a strong Ligament that is extended to the *Os cuneiforme* and *pisiforme* of the Wrist. — Between the Back-part of that internal smooth Side and this Process, a Sinuosity is left for the Tendon of the *Extensor carpi ulnaris*. — On the Fore-part of the Root of the Process, such another Depression may be remarked for the Passage of the *ulnar* Artery and Nerve. — The End of the Bone is smooth and covered with a Cartilage. — Between it and the Bones of the Wrist, a doubly-concave moveable Cartilage is interposed; which is a Continuation of the Cartilage that covers the lower End of the *Radius*, and is connected loosely to the Root of the *styloid* Process, and to the rough Cavity there; in which mucaginous Glands are lodged.

The *Ulna* is articulated above with the lower End of the *Os humeri* by *Ginglimus*, which allows an easy and secure Extension to almost a streight Line with the Arm, and Flexion to a very acute Angle; but, by the slanting Position of the Pully, the lower Part of the Fore-arm is turned outwards in the Extension, and inwards in the Flexion (a); and a very small kind of Rotation is likewise allowed in all Positions, especially when the Ligaments are most relaxed

† Γραφοειδής, Malleolus externus.

(a) Winslow. Memoirs de l'Acad. des Sciences, 1722.

laxed by the Fore-arm being in a middle Degree of Flexion.—The *Ulna* is also articulated with the *Radius* and *Carpus*, in a Manner to be related afterwards.

RADIUS †, so called from its imagined Resemblance to a Spoke of a Wheel, or to a Weaver's Beam, is the Bone placed at the Inside of the Fore-arm. Its upper End is formed into a circular little Head, which is hollowed for an Articulation by *Enarthrosis* with the Tubercle at the Side of the Pulley of the *Os humeri*; and the half of the round Circumference of the Head next to the *Ulna* is smooth, and covered with a Cartilage, in order to be received into the semilunated Cavity of that Bone.—Below the Head, the *Radius* is much smaller; therefore this Part is named its *Cervix*, which is made round by the Action of the *Supinator radii brevis*.——At the external Root of this Neck, a tuberos Process rises; into the outer Part of which the *Biceps flexor cubiti* is inserted.—From this a Ridge runs downwards and inwards, where the *Supinator radii brevis* is inserted; and a little below, and behind this Ridge, there is a rough scabrous Surface, where the *Pro-nator radii teres* is fixed.

The Body of the *Radius* is not streight, but convex on its internal and posterior Surfaces; where it is also made round by the equal Pressure of the circumjacent Muscles, particularly of the *Extensors* of

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the

† Κερκίς, παράπληχιον, Focile minus, Canna minor, Arundo minor.

the Thumb; but the Surfaces next to the *Ulna* are flatted and rough, for the Origin of the Muscles of the Hand; and both terminate in a common sharp Spine, to which the strong Ligament extended betwixt the two Bones of the Fore-arm is fixed. — A little below the Beginning of the plain Surface, on its Fore-part, where the *Flexor* Muscle of the last Joint of the Thumb takes its Origin, the Passage of the medullary Vessels is seen slanting upwards. — The *Radius* becomes broader and flatter towards the lower End, especially on its Fore-part, where its *Pronator quadratus* Muscle is situated.

The lower End of the *Radius* is larger than the superior; though not in such a Disproportion, as the upper End of the *Ulna* is larger than its lower End. — Its Back-part has a flat strong Ridge in the Middle, and *Fossæ* on each Side. — In a small Groove, immediately on the Outside of the Ridge, the Tendon of the *Extensor tertii internodii pollicis* plays. — In a large one beyond this, the Tendons of the *Indicator* and of the common *Extensor* Muscles of the Fingers pass. — Contiguous to the *Ulna*, there is a small Depression made by the *Extensor minimi digiti*. — On the Inside of the Ridge there is a broad Depression, which seems again subdivided, where the two Tendons of the *Bicornis*, or *Extensor carpi radialis*, are lodged. — The internal Side of this End of the *Radius*, is also hollowed by the Extensors of the first and second Joint
of

of the Thumb; immediately above which, a little rough Surface shews where the *Supinator radii longus* is inserted. — The Ridges at the Sides of the Grooves, in which the Tendons play, have an annular Ligament fixed to them, by which the several Sheaths for the Tendons are formed. — The Fore-part of this End of the *Radius* is also depressed, where the Flexors of the Fingers and *Flexor carpi radialis* pass. — The external Side is formed into a semilunated smooth Cavity, lined with a Cartilage, for receiving the lower End of the *Ulna*. — The lowest Part of the *Radius* is formed into an oblong Cavity; in the Middle of which is a small transverse Rising, gently hollowed, for lodging mucilaginous Glands; while the Rising itself is insinuated into the Junction of the two Bones of the Wrist that are received here. — The internal Side of this Articulation is fenced by a remarkable Process * of the *Radius*, from which a Ligament goes out to the Wrist, and the *styloid* Process of the *Ulna* guards it on the Outside.

The Ends of both the Bones of the Fore-arm being thicker than their Middle, there is a considerable Distance between the Bodies of these Bones; in the larger Part of which a strong tendinous, but thin Ligament, is extended, to give a large enough Surface for the Origin of the numerous Fibres of the Muscles situated here, that are so much sunk between the Bones, as to be protected from

Z 2

Injuries,

* Malleolus internus, Processus styloides.

Injuries, which they would otherwise be exposed to. But this Ligament is wanting near the upper End of the Fore-arm, where the *Supinator radii brevis*, and *Flexor digitorum profundus*, are immediately connected (a).

Both Ends of the Bones of the Fore-arm, are first Cartilages, and then *Epiphyses*, in Children.

The *Radius* is articulated with the Tubercle of the *Os humeri* by *Enarthrosis*; and therefore is bended and extended along with the *Ulna*, while it may here move round its *Axis* in any Position; and that this Motion round its *Axis* may be sufficiently large, the Ligament of the Articulation is extended farther down than ordinary on the Neck of this Bone, before it is connected to it; and it is very thin at its upper and lower Part, but makes a firm Ring in the Middle. — This Bone is also joined to the *Ulna* by a double *Enarthrosis*, the *Radius* being received above, and the *Ulna* below; which, conjunctly considered, form the third Species of *Ginglimus*: But then the Motion performed in these two is very different; for at the upper End, the *Radius* does no more than turn round its *Axis*; while at the lower, it moves in a sort of *Cycloid*, upon the round End of the *Ulna*; and as the Hand is articulated and firmly connected here with the *Radius*, they must move together. — When the Palm is turned uppermost, the *Radius* is said to perform the *Supination*; when the

(a) *Weitbrecht. Syndesmolog. Fig. 10. 11.*

the Back of the Hand is above, it is said to be *Prone*. But then the Quickness and large Extent of these two Motions are assisted by the *Ulna*, which, as was before observed, can move with a kind of small Rotation on the sloping Sides of the Pulley. This lateral Motion, though very inconsiderable in the Joint itself, is conspicuous at the lower End of such a long Bone; and the strong Ligament connecting this lower End to the *Carpus*, makes the Hand more readily to obey these Motions.—When we design a large circular Turn of our Hand, we increase it by the Rotation of the *Os humeri*, and sometimes employ the Spine and *inferior Extremities*, to make these Motions of Pronation and Supination of the Hand large enough.

The *HAND* * comprehends all from the Joint of the Wrist to the Points of the Fingers. All its Back-part is convex, for greater Firmness and Strength; and it is concave before, for containing more surely and conveniently such Bodies as we take hold of:—One half of the Hand has an obscure Motion in comparison of what the other has, and serves as a Base to the moveable Half; which can be extended back very little farther than to a streight Line with the Fore-arm, but can be considerably bended forwards.

As the Bones that compose the Hand are of different Shapes and Uses, while several

Z 3

of

* *Ἀπὸ χειρ*, *Summa Manus*.

of them that are contiguous agree in some general Characters; the Hand is, on this account, commonly divided into the *Carpus*, *Metacarpus*, and *Fingers*; among which last the Thumb is reckoned.

The *CARPUS* * is composed of eight small spungy Bones, situated at the upper Part of the Hand. I shall describe each of these Bones under a proper Name taken from their Figure (*a*), because the Method of ranging them by Numbers, leaves Anatomists too much at liberty to debate, very idly, which ought to be preferred to the first Number; or, which is worse, several, without explaining the Order they observe, differently apply the same Numbers, and so confound their Readers.—But that the Description of these Bones may be in the same Order as they are found in the Generality of Anatomical Books, I shall begin with that Range of Bones, that are concerned in the moveable Joint of the Wrist, or are connected to the Fore-arm, and shall afterwards consider the four that support the Thumb and *Ossa Metacarpi* of the Fingers.

The eight Bones of the *Carpus* are, *Oscaphoïdes*, *lunare*, *cuneiforme*, *pisiforme*, *trapezium*, *trapezoides*, *magnum*, and *unciforme*.

The *Scaphoïdes* is situated most internally of those that are articulated with the Fore-arm.—The *Lunare* is immediately on the Outside of the former.—The *Cuneiforme* is placed still more externally, but does not reach

* *Kreis*, Brachiale, prima palmæ pars, rafetta.

(*a*) *Lyser. Cult. Anat. lib. 5. cap. 2.*

reach so high up as the other two.—The *Pisiforme* stands forwards into the Palm from the *Cuneiform*.—The *Trapezium* is the first of the second Row, and is situated betwixt the *Scaphoides* and first Joint of the Thumb.—The *Trapezoides* is immediately on the Outside of the *Trapezium*.—The *Os magnum* is still more external;—The *Unciforme* is farthest to the Side of the Little-finger.

Scaphoides * is the largest of the eight except one. It is convex above, concave and oblong below; from which small Resemblance of a Boat it has got its Name.—Its smooth convex Surface is divided by a rough middle *Fossa*, which runs obliquely cross it.—The upper largest Division is articulated with the *Radius*.—Into the *Fossa* the common Ligament of the Joint of the Wrist is fixed; and the lower Division is joined to the *Trapezium* and *Trapezoides*.—The Concavity receives more than an half of the round Head of the *Os magnum*.—The external Side of this Hollow is formed into a semilunar Plane, to be articulated with the following Bone.—The internal, posterior and anterior Edges, are rough, for fixing the Ligaments that connect it to the surrounding Bones.

Os lunare † has a smooth convex upper Surface, by which it is articulated with the *Radius*.—The internal Side, which gives the Name to the Bone, is in the Form of

a

* Κοτυλοειδής, Naviculare.

† Lunatum.

a Crescent, and is joined with the *Scaphoid*; —the lower Surface is hollow, for receiving part of the Head of the *Os magnum*.—On the Outside of this Cavity is another smooth, but narrow oblong Sinuosity, for receiving the upper End of the *Os unciforme*: —on the Outside of which a small round Convexity is found, for its Connexion with the *Os cuneiforme*.—Between the great Convexity above, and the first deep inferior Cavity, there is a rough *Fossa*, in which the circular Ligament of the Joint of the Wrist is fixed.

Os cuneiforme * is broader above, and towards the Back of the Hand, than it is below and forwards; which gives it the Resemblance of a Wedge.—The superior slightly convex Surface is included in the Joint of the Wrist, being opposed to the lower End of the *Ulna*. Below this the cuneiform Bone has a rough *Fossa*, wherein the Ligament of the Articulation of the Wrist is fixed.—On the internal Side of this Bone, where it is contiguous to the *Os lunare*, it is smooth and slightly concave.—Its lower Surface, where it is contiguous to the *Os unciforme* is oblong, somewhat spiral, and concave.—Near the Middle of its anterior Surface a circular Plane appears, where the *Os pisiforme* is sustained.

Os pisiforme † is almost spherical, except one circular Plane, or slightly hollow Surface, which is covered with Cartilage for its Motion

* *Triquetrum*.

† *Cartilaginosum, subrotundum, rectum*.

Motion on the *cuneiform* Bone, from which its whole rough Body is prominent forwards into the Palm; having the Tendon of the *Flexor carpi ulnaris*, and a Ligament from the *styloid* Process of the *Ulna*, fixed to its upper Part; the *transverse* Ligament of the Wrist is connected to its internal Side; Ligaments extended to the *unciform* Bone, and to the *Os metacarpi* of the Little-finger, are attached to its lower Part; and the *Abductor minimi digiti* has its Origin from its Fore-part; and, at the internal Side of it, a small Depression is formed, for the Passage of the ulnar Nerve.

Trapezium * has four unequal Sides and Angles in its Back-part, from which it has got its Name.—Above, its Surface is smooth, slightly hollowed, and semicircular, for its Conjunction with the *Os scaphoides*.—Its external Side is an oblong concave Square, for receiving the following Bone.—The inferior Surface is formed into a Pulley; the two protuberant Sides of which are external and internal. On this Pulley the first Bone of the Thumb is moved.—At the external Side of the external Protuberance, a small oblong smooth Surface is formed by the *Os metacarpi indicis*.—The Fore-part of the *Trapezium* is prominent in the Palm, and, near to the external Side, has a Sinuosity in it, where the Tendon of the *Flexor carpi radialis* is lodged; on the ligamentous Sheath of which the Tendon of the *Flexor tertii internodii pollicis* plays: And still more externally

* *Os cubiforme, trapezoides, multangulum majus.*

ternally the Bone is scabrous, where the *transverse* Ligament of the Wrist is connected, the *Abductor* and *Flexor primi internodii pollicis* have their Origin, and Ligaments go out to the first Bone of the Thumb.

Os trapezoides *, so called from the irregular quadrangular Figure of its Back-part, is the smallest Bone of the Wrist, except the *Pisiforme*.—The Figure of it is an irregular Cube.—It has a small hollow Surface above, by which it joins the *Scaphoides*; a long convex one internally, where it is contiguous to the *Trapezium*; a small external one, for its Conjunction with the *Os magnum*; and an inferior convex Surface, the Edges of which are however so raised before and behind, that a sort of Pulley is formed, where it sustains the *Os metacarpi indicis*.

Os magnum †, so called because it is the largest Bone of the *Carpus*, is oblong, having four quadrangular Sides, with a round upper End, and a triangular plain one below.—The round Head is divided by a small Rising, opposite to the Connexion of the *Os scaphoides* and *lunare*; which together form the Cavity for receiving it.—On the Inside a short plain Surface joins the *Os magnum* to the *Trapezoides*.—On the Outside is a long narrow concave Surface, where it is contiguous to the *Os unciforme*.—The lower End, which sustains the metacarpal

* *Trapezium*, multangulum minus.

† *Maximum*, capitatum.

metacarpal Bone of the Middle-finger, is triangular, slightly hollowed, and farther advanced on the internal Side than on the external, having a considerable oblong Depression made on that advanced Inside by the metacarpal Bone of the Fore-finger; and generally there is a small Mark of the *Os metacarpi digiti annularis* on its external Side.

Os unciforme * which has got its Name from a thin broad Process that stands out from it forwards into the Palm, is hollow on its Inside, for affording Passage to the Tendons of the Flexors of the Fingers. To this Process also the transverse Ligament is fixed, that binds down and defends these Tendons; and the *Flexor* and *Abductor* Muscles of the Little-finger have part of their Origin from it.—The upper plain Surface is small, convex, and joined with the *Os lunare*:—The internal Side is long, and slightly convex, adapted to the contiguous *Os magnum*:—The external Surface is oblique, and irregularly convex, to be articulated with the cuneiform Bone:—The lower End is divided into two concave Surfaces; the external is joined with the metacarpal Bone of the Little-finger, and the internal one is fitted to the metacarpal Bone of the Ring-finger.

In the Description of the preceeding eight Bones, I have only mentioned those plain Surfaces covered with Cartilage, by which they are articulated to each other, or to some other Bones, except in some
few

* Cuneiforme.

few Cases, where something extraordinary was to be observed; and I have designedly omitted the other rough Surfaces, lest, by crowding too many Words in the Description of such small Bones, the whole should be unintelligible: But these scabrous Parts of the Bones may easily be understood, after mentioning their Figure, if it is observed, that they are generally found only towards the Back or Palm of the Hand; that they are all plain, larger behind than before; and that they receive the different Ligaments, by which they are either connected to neighbouring Bones, or to one another; for these Ligaments cover all the Bones, and are so accurately applied to them, that, at first View, the whole *Carpus* of a recent Subject appears one smooth Bone (a).

As the Surfaces of these Bones are largest behind, the Figure of the whole conjoined must be convex there, and concave before; which Concavity is still more increased by the *Os pisiforme*, and Process of the *Os unciforme*, standing forwards on one Side, as the *Trapezium* does on the other: And the Bones are securely kept in this Form, by the broad strong transverse Ligament connected to these Parts of them that stand prominent into the Palm of the Hand.—The Convexity behind renders the whole Fabric stronger, where it is most

(a) *Galen*, de usu Part. lib. 2. cap. 8. For a particular Description of these Ligaments, see *Weitbrecht*. Syndesmolog. p. 35.—68.

most exposed to Injuries; and the large anterior Hollow is necessary for a safe Passage to the numerous Vessels, Nerves, and Tendons of the Fingers.

The Substance of these Bones is spongy and cellular, but strong in respect of their Bulk.

The three first Bones of the *Carpus* make an oblong Head, by which they are articulated to the lower Ends of the Bones of the Fore-arm by *Enarthrosis*; and therefore can be moved to all Sides, and, by a quick Succession of these Motions, may be moved in a Circle. But as the Joint is oblong, and therefore the two Dimensions are unequal, no Motion is allowed to the *Carpus* round its Axis, except what it has in the Pronation and Supination along with the *Radius*.—The Articulation of the first three Bones of the superior Row, with the Bones of the inferior, is such as allows of Motion, especially backwards and forwards; to the Security and Easiness of which the *Enarthrosis* of the *Os magnum*, with the *Scaphoides* and *Lunare* contributes considerably: And the greatest Number of the Muscles that serve for the Motion of the Wrist on the *Radius*, being inserted beyond the Conjunction of the first Row of Bones with the second, act equally on this Articulation as they do on the former; but the Joint formed with the *Radius* being the most easily moved, the first Effect of these Muscles is on it; and the second Row of the *Carpus* is only moved afterwards. By

A a

this

this means a larger Motion of the Wrist is allowed than otherwise it could have had safely: For, if as large Motion had been given to one Joint, the Angle of Flexion would have been very acute, and the Ligaments must have been longer than was consistent with the Firmness and Security of the Joint. — The other Articulations of the Bones here being by nearly plain Surfaces, which I called *Arthrodia*, scarce allow of any more Motion, because of the strong connecting Ligaments, than to yield a little, and so elude the Force of any external Power; and to render the Back of the Wrist a little more flat, or the Palm more hollow, on proper Occasions. The Articulations of the Thumb and metacarpal Bones shall be examined afterwards.

The Uses of the *Carpus* are, to serve as a Base to the Hand, to protect its Tendons, and to afford it a free large Motion.

All the Bones of the *Carpus* are in a cartilaginous State at the Time of Birth.

On account of the many Tendons that pass upon the lower End of the Fore-arm and the *Carpus*, and of the numerous Ligaments of these Tendons and of the Bones, which have lubricating Liquors supplied to them, the Pain of Strains here is acute, the Parts take long Time to recover their Tone, and their Swellings are very obstinate.

METACARPUS † consists of four Bones which sustain the Fingers. — Each Bone is long

† Κτάς, προχάρπιον, ἑῷδος, ἀνδρον, κτενίον. Postbrachiale, pectus, palma, pecten.

long and round, with its Ends larger than its Body.—The Upper End, which some call the Base, is flat and oblong, without any considerable Head or Cavity; but is however somewhat hollowed, for the Articulation with the *Carpus*: It is made flat and smooth on the Sides where these Bones are contiguous to each other.—Their Bodies are flattened on their Back-part by the Tendons of the Extensors of the Fingers.—The anterior Surface of these Bodies is a little concave, especially in their Middle; along which a sharp Ridge stands out, which separates the *musculi interossei* placed on each Side of these Bones, which are there made flat and plain by these Muscles.

Their lower Ends are raised into large oblong smooth Heads, whose greatest Extent is forwards from the Axis of the Bone.—At the Fore-part of the Root of each of these Heads, one or two Tubercles stand out, for fixing the Ligaments that go from one metacarpal Bone to another, to preserve them from being drawn asunder:—Round the Heads a rough Ring may be remarked, for the capsular Ligaments of the first Joints of the Fingers to be fixed to; and both Sides of these Heads are flat, by pressing on each other.

The Substance of the metacarpal Bones is the same with that of all long Bones.

At the Time of Birth, these Bones are cartilaginous at both Ends, which afterwards become *Epiphyses*.

The metacarpal Bones are joined above to the *Ossa Carpi* by *Arthrodia*; but having different Surfaces by which they are contiguous to each other, their mutual Articulation comes under what I called the *third* Species of *Ginglimus*. These Connections are not fit for large Motions.—The Articulation of their round Heads at their lower Ends with the first Bones of the Fingers, is by *Enarthrosis*; of which hereafter.

The Concavity on the Fore-part of these metacarpal Bones, and the placing their Bases on the arched *Carpus*, cause them to form a Hollow in the Palm of the Hand, which is useful often to us.—The Space between them lodge Muscles, and their small Motion makes them fit Supporters for the Fingers to play on.

Though the *Ossa metacarpi* so far agree, yet they may be distinguished from each other by the following Marks.

The *Os metacarpi indicis* is generally the longest.—Its Base, which is articulated with the *Os trapezoides*, is hollow in the Middle.—The small Ridge on the internal Side of this oblong Cavity is smaller than the one opposite to it, and is made flat on the Side by the *Trapezium*.—The exterior Ridge is also smooth, and flat on its Outside, for its Conjunction with the *Os magnum*; immediately below which a semicircular smooth flat Surface shews the Articulation of this to the second metacarpal Bone.—The Back-part of this Base is flatted, where the long
Head

Head of the *Extensor carpi radialis* is inserted; and its Fore-part is prominent, where the Tendon of the *Flexor carpi radialis* is fixed.—The external Side of the Body of this Bone is more hollowed by the Action of Muscles, than the internal.—The Tubercle at the internal Root of its Head is larger than the external.—Its Base is so firmly fixed to the Bones it is connected with, that it has no Motion.

Os metacarpi medii digiti is generally the second in Length; but often it is as long as the former; sometimes it is longer; and frequently it only appears to equal the first, by the *Os magnum* being farther advanced downwards than any other Bone of the Wrist.—Its Base is a broad superficial Cavity, slanting outwards; the internal posterior Angle of which is so prominent, as to have the Appearance of a Process.—The internal Side of this Base is made plain in the same Way as the external Side of the former Bone, while its external Side has two hollow circular Surfaces, for joining the third metacarpal Bone; and between these Surfaces there is a rough *Fossa*, for the Adhesion of a Ligament, and lodging mucilaginous Glands.—The shorter Head of the *Bicornis* is inserted into the Back-part of this Base.—The two Sides of this Bone are almost equally flattened; only the Ridge on the Fore-part of the Body inclines outwards.—The Tubercles at the Fore-part of the Root of the Head are equal.—The

Motion of this Bone is very little more than the first metacarpal one has; and therefore these two firmly resist Bodies pressed against them by the Thumb, or Fingers, or both.

Os metacarpi digiti annularis is shorter than the second metacarpal Bone.—Its Base is semicircular and convex, for its Conjunction with the *Os unciforme*.—On its internal Side are two smooth Convexities, and a middle *Fossa*, adapted to the second metacarpal Bone.—The external Side has a triangular smooth concave Surface, to join it with the fourth one. The anterior Ridge of its Body is situated more to the Out than to the In side.—The Tubercles near the Head are equal.—The Motion of this third metacarpal Bone is greater than the Motion of the second.

Os metacarpi minimi digiti is the smallest and sharpest.—Its Base is irregularly convex, and rises slanting outwards.—Its internal Side is exactly adapted to the third metacarpal Bone.—The external has no smooth Surface, because it is not contiguous to any other Bone; but it is prominent where the *Extensor carpi ulnaris* is inserted.—As this *Os metacarpi* is furnished with a proper moving Muscle, has the plainest Articulation, is most loosely connected and least confined, it not only enjoys a much larger Motion than any of the rest, but draws the third Bone with it, when the Palm of the Hand is to be made hollow, by its Advancement forwards, and by the Prominence of the Thumb opposite to it.

The

The *THUMB* and four *FINGERS* are each composed of three long Bones.

The *Thumb* * is situated obliquely in respect of the *Fingers*, neither opposite directly to them, nor in the same Plane with them. — All its Bones are much thicker and stronger in proportion to their Length, than the Bones of the *Fingers* are: Which was extremely necessary, since the *Thumb* counteracts all the *Fingers*.

The first Bone of the *Thumb* has its Base adapted to the double Pulley of the *Trapezium*: For, in viewing it from one Side to the other, it appears convex in the Middle; but when considered from behind forwards, it is concave there. — The Edge at the Fore-part of this Base is produced farther than any other Part; and round the Back-part of the Base a rough *Fossa* may be seen, for the Connexion of the Ligaments of this Joint. — The Body and Head of this Bone are of the same Shape as the *Ossa metacarpi*; only that the Body is shorter, and the Head flatter, with the Tubercles at the Fore-part of its Root larger.

The Articulation of the upper End of this Bone is uncommon: For though it is a *Ginglimus*, yet it enjoys the Motion of an *Enarthrosis*, by being formed into a double Pulley; only it is somewhat more confined and less expeditious, but stronger and more secure, than generally the *Enarthrosis* is.

This Bone of Children is in the same State with the metacarpal Bones.

The

* *Ἀντίχειρ, δικοῦδυλός*, *Magnus digitus, pollex*.

The second Bone of the Thumb has a large Base formed into an oblong Cavity, whose greatest Length is from one Side to the other.—Round it several Tubercles may be remarked, for the Insertion of Ligaments.—Its Body is convex, or a Half-round behind ; but flat before, for lodging the Tendon of the long Flexor of the Thumb, which is tied down by ligamentous Sheaths that are fixed on each Side to the Angle at the Edge of this flat Surface.—The lower End of this second Bone has two lateral round Protuberances, and a middle Cavity, whose greatest Extent of smooth Surface is forwards.

The Articulation and Motion of the upper End of this second Bone is as singular as that of the former.—For it is articulated by *Enarthrosis* ; yet because of the Strength of its lateral Ligaments, oblong Figure of the Joint itself, and Mobility of the first Joint, it only has the two Motions of a *Ginglimus*, Flexion and Extension ; and these are generally much confined.

The third Bone of the Thumb is the smallest, with a large Base, whose greatest Extent is from one Side to the other.—This Base is formed into two Cavities and a middle Protuberance, to be adapted to the Pulley of the former Bone.—Its Body is rounded behind ; but is flatter than in the former Bone, for sustaining the Nails.—It is flat and rough before, by the Insertion of the *Flexor tertii internodii*.—This Bone becomes gradually smaller, till near the
lower

lower End, where it is a little enlarged, and has an oval scabrous Edge.

The Motion of this third Bone is proper to its Articulation *Ginglimus*.

The orderly Disposition of the Bones of the *Fingers* into three Rows, has made them generally obtain the Name of three *Phalanges* *.—All of them have half-round convex Surfaces, covered with an *Aponeurosis*, formed by the Tendons of the *Extensors*, *Lumbricales*, and *Interossei*, and placed directly backwards, for their greater Strength; and their flat concave Part is forwards, for taking hold more surely, and for lodging the Tendons of the Flexor Muscles.—The Ligaments for keeping down these Tendons are fixed to the Angles that are between the convex and concave Sides.

The Bones of the first *Phalanx* † of the *Fingers* answer to the Description of the second Bone of the Thumb: Only that the Cavity in their Base is not so oblong; nor is their Motion on the metacarpal Bones so much confined; for they can be moved laterally or circularly, but have no Rotation round their Axes.

Both the Ends of this first *Phalanx* are in a cartilaginous State at the Birth; and the upper one is afterwards affixed in Form of an *Epiphysis*.

The

* *Scytalidæ, internodia, scuticula, agmina, acies, condyli, articuli.*

† *Προκαρδια.*

The second Bone * of the Fingers has its Base formed into two lateral Cavities, and a middle Protuberance ; while the lower End has two lateral Protuberances and a middle Cavity ; therefore it is joined at both Ends by *Ginglimus*, which none of the Bones of the Thumb are.

This Bone is in the same Condition with the former in Children.

The third Bone ‡ differs nothing from the Description of the third Bone of the Thumb, excepting in the general distinguishing Marks ; and therefore the second and third *Phalanx* of the Fingers enjoy only Flexion and Extension.

The upper End of this third *Phalanx* is a Cartilage in a ripe Child ; and is only an *Epiphyse* after, till the full Growth of the Body.

All the Difference of the *Phalanges* of the several Fingers consists in their Magnitude. — The Bones of the *Middle-finger* ** being the longest and largest, — those of the *Fore-finger* † come next to that. — Those of the *Ring-finger* ‡‡ are the third in Size ; and the *Little-finger* || has the smallest Bones. Which Disposition is the best Contrivance for holding the largest Bodies ; because the longest Fingers

* Κόνδυλοι.

† Μετακόνδυλοι, ριζανύχια.

** Καταπυχών, σάκελος, infamis, impudicus, verpus, sanctus, obscænus.

† Δεικτικός, indicator, λιχανός, demonstrativus, salutaris.

‡‡ Ίατρικός, παράμεσος, δακτυλιώτης, επιβάτης, Annularis medicus, cordis digitus.

|| Μύαψ, ώτίτης, Auricularis, minimus.

Fingers are applied to the middle largest Periphery of such Substances as are of a spherical Figure (a).

The Uses of all the Parts of our *superior Extremities* are so evident in the common Actions of Life, that it is needless to enumerate them here; and therefore I shall proceed to the last Part of the Skeleton. Only, lest I should seem to have forgot the small Bones at the Joints of the Hand, I desire now to refer to the Description of them, under the common Title of *Sesamoid Bones*, which I have placed after the Bones of the Feet.

Of the INFERIOR EXTREMITIES.

THE INFERIOR EXTREMITIES depend from the *Acetabula* of the *Ossa innominata*; and are commonly divided into three Parts, *viz.* the Thigh, Leg, and Foot.

The *THIGH** has only one Bone; which is the longest of the Body, and the largest and strongest of any of the cylindrical Bones. The Situation of it is not perpendicular: For the lower End is inclined considerably inwards; so that the Knees are almost contiguous, while there is a considerable Distance between the Thigh-bones above: Which is of good Use to us, since sufficient Space is thereby left for the external Parts of Generation, the two great *Cloacæ* of Urine

(a) *Galen. de usu part. lib. 1. cap. 24.*

* *Μυρὸν*, Femur, coxa, agis, anchæ os, crus, femur.

rine and *Fæces*, and for the large thick Muscles that move the Thigh inwards: And at the same time this Situation of the Thigh-bones renders our Progression quicker, surer, streighter, and in less Room; for had the Knees been at a greater Distance from each other, we must have been obliged to describe some Part of a Circle with the Trunk of our Body in making a long Step, and, when one Leg was raised from the Ground, our Center of Gravity would have been too far from the Base of the other, and we should consequently have been in Hazard of falling; so that our Steps would neither have been straight nor firm; nor would it have been possible to walk in a narrow Path, had our Thigh-bones been otherwise placed. In consequence however of the Weight of the Body bearing so obliquely on the Joint of the Knee, by this Situation of the Thigh-bones, weak rickety Children become in-kneed.

The upper End of the Thigh-bone is not continued in a straight Line with the Body of it, but is set off obliquely inwards and upwards, whereby the Distance here between these two Bones at their upper Part is considerably increased.—This End is formed into a large smooth round Head †, which is the greater Portion of a Sphere unequally divided.—Towards its lower internal Part a round rough spongy Pit is observable, where

† Vertebrium.

where the strong Ligament, commonly, but unjustly, called the *round one*, is fixed, to be extended from thence to the lower internal Part of the receiving Cavity, where it is considerably broader than near to the Head of the Thigh-bone.—The small Part below the Head, called the *Cervix*, of the *Os Femoris*, has a great many large Holes, into which the Fibres of the strong Ligament, continued from the capsular, enter, and are thereby surely united to it; and round the Root of the Neck, where it rises from the Bone, a rough Ridge is found, where the capsular Ligament of the Articulation itself is connected.—Below the Back-part of this Root, the large unequal Protuberance, called *Trochanter major* †, stands out; the external convex Part of which is distinguished into three different Surfaces, whereof the one on the Fore-part is scabrous and rough, for the Insertion of the *Glutæus minimus*; the superior one is smooth, and has the *Glutæus medius* inserted into it; and the one behind is made flat and smooth by the Tendon of the *Glutæus maximus* passing over it.—The upper Edge of this Process is sharp and pointed at its Back-part, where the *Glutæus medius* is fixed; but forwards it is more obtuse, and has two superficial Pits formed in it: Into the superior of these, the *Pyriformis* is implanted; and the *Obturator internus* and *Gemini* are fixed into the lower one.—From the backmost prominent Part of this great *Trochanter*, a

B b

rough

† Γλυστός, Rotator natis, malum granatum testicularum.

rough Ridge runs backwards and downwards, into which the *Quadratus* is inserted.—In the deep Hollow, at the internal upper Side of this Ridge, the *Obturator externus* is implanted.—More internally, a conoid Process, called *Trochanter minor* †. rises for the Insertion of the *Musculus Psoas*, and *Iliacus internus*, and the *Pectineus*, is implanted into a rough Hollow below its internal Root.—The Muscles inserted into these two Processes being the principal Instruments of the rotatory Motion of the Thigh, have occasioned the Name of *Trochanters* to the Processes.—The Tendons that are fixed into, or pass over the great *Trochanter*, cause Bruises by Falls on this Part to be attended with great Pain and Weakness of the Limb, which generally remain long.

The Body of the *Os femoris* is convex on the Fore-part, and made hollow behind, by the Action of the Muscles that move upon it, and for the Conveniency of sitting, without bearing so much on these Muscles; and probably the Weight of the Legs depending from the Thighs in that Posture, contributes to this Curvature.—The Fore-part of the Thigh-bone is a little flatted above by the Beginning of the *Crureus* Muscle, as it is also below by the *Rectus* and *Crureus*.—Its external Surface is likewise made flat below by the *Vastus externus*, where it is separated from the former by an obtuse Ridge.—The *Vastus internus* depresses a little the low-

er

† Rotator minor.

er Part of the internal Surface.—The posterior concave Surface has a Ridge rising in its Middle, commonly called *Linea aspera*, into which the *Triceps* is inserted, and the short Head of the *Biceps flexor tibiæ* rises from it.—At the upper Part of it the medullary Vessels enter by a small Hole that runs obliquely upwards.—A little above which there is a rough *Fossa* or two, where the Tendon of the *Glutæus maximus* is fixed.—The lower End of the *Linea aspera* divides into two, which descend towards each Side—The two *vasti* Muscles have part of their Origin from these Ridges; and the long Tendon of the *Triceps* is fixed to the internal, by means of part of the *Fascia aponeurotica* of the Thigh.—Near the Beginning of the internal Ridge, there is a Discontinuation of the Ridge, where the crural Artery passes through the *Aponeurosis*.—Between these two rough Lines, the Bone is made flat by the large Blood-vessels and Nerves which pass upon it; and near the End of each of these Ridges, a small smooth Protuberance may often be remarked, where the two Heads of the *Musculi Gastrocnemii externi* take their Rise, and where sesamoid Bones are sometimes found (a); and from the Fore-part of the internal Tubercle, a strong Ligament is extended to the Inside of the *Tibia*.

The lower End of the *Os femoris* is larger than any other Part of it, and is formed

B b 2

into

(a) Vesal. Lib. 1. cap. 28. & 30.

into a great Protuberance on each Side, called its *Condyles*; between which a considerable Cavity is found, especially at the Back-part, in which the crural Vessels and Nerves ly immersed in Fat.—The internal Condyle is longer than the external, which must happen from the oblique Position of this Bone, to give less Obliquity to the Leg. —Each of these Processes seems to be divided in its plain smooth Surface. The Mark of Division on the external is a Notch, and on the internal a Protuberance. The Fore-part of this Division, on which the *Rotula* moves, is formed like a Pulley, the external Side of which is highest.—Behind, there are two oblong large Heads, whose greatest Extent is backwards, for the Motion of the *Tibia*; and from the rough Cavity between them, but near to the Base of the internal Condyle, the strong Ligament, commonly called the *cross* one, has it Rise. —A little above which a rough Protuberance gives Insertion to the Tendon of the *Triceps*. —The Condyles, both on the Outer and Inner Side of the Knee, are made flat by the Muscles passing along them.—On the Back-part of the internal, a slight Depression is made by the Tendons of the *Gracilis* and *Sartorius*; and on the external such another is formed by the *Biceps flexor cruris*; behind which a deep *Fossa* is to be observed, where the *Poplitæus* Muscle has its Origin. —From a Tubercle immediately before this Cavity, a strong round Ligament goes out to the upper Part of the *Fibula*.—

Round

Round this lower End of the Thigh-bone, large Holes are found, into which the Ligaments for the Security of the Joint are fixed, and Blood-vessels pass to the internal Substance of the Bone.

All the Processes of the *Femur* are cartilaginous in new-born Children, and afterwards become small *Apophyses*, with large *Epiphyses*.

The Thigh-bone is articulated above with the *Acetabulum* of the *Ossa innominata* by *Enarthrosis*, and therefore can be moved to every Side; but is restrained in its Motion outwards, by the high Brims of the Cavity, and by the round Ligament; for otherwise the Head of the Bone would have been frequently thrust out at the Breach of the Brims on the Inside, which allows the Thigh to move considerably inwards.—The Body of this Bone enjoys little or no rotatory Motion, though the Head most commonly moves round its own Axis; because the oblique Progress of the Neck and Head from the Bone is such, that the rotatory Motion of the Head can only bring the Body of the Bone forwards and backwards: Nor is this Head, as in the Arm, ever capable of being brought to a streight Direction with its Body; so far however as the Head can move within the Cavity in a Circle backwards and forwards, the rest of the Bone may have a partial Rotation.—The *Os femoris* is articulated below to the *Tibia* and *Rotula* by *Ginglimus*.

The Nearness of the small Neck to the round Head of the Thigh-bone, and its upper End being covered with very thick Muscles, make greater Difficulty in distinguishing between a Luxation and Fracture here, than in any other Part of the Body.

The *LEG* * is composed, according to the common Account, of two Bones, *Tibia* and *Fibula*, though it seems to have a very good Title to a third, the *Rotula*; which bears a strong Analogy to the *Olecranon* of the *Ulna*, and moves always with the other two.

TIBIA †, so called from its Resemblance to an old musical Pipe or Flute, is the long thick triangular Bone, situated at the internal Part of the Leg, and continued in almost a straight Line from the Thigh-bone.

The upper End of the *Tibia* is large, bulbous, and spongy, and is divided into two Cavities, by a rough irregular Protuberance ‡, which is hollow at its most prominent Part, as well as before and behind. The anterior of the two Ligaments that compose the great *cross* one, is inserted into the middle Cavity, and the Depression behind receives the posterior Ligament.—The two broad Cavities at the Sides of this Protuberance are not equal; for the internal is oblong and deep, to receive the internal
Condyle

* *Κνήμιν*, Crus, tibia.

† *Προκνήμιον*, *ἀντικνήμιον*, *foeile majus*, *arundo major*, *canna major*, *canna domestica cruris*.

‡ *Διάφυσος*, *ἐξοχή νευροχονδρώδης*, Tuber, tuberculum.

Condyle of the Thigh-bone; while the external is more superficial and rounder, for the external *Condyle*. — In each of these two Cavities of a recent Subject, a semilunar Cartilage is placed, which is thick at its convex Edge, and becomes gradually thinner towards the concave or interior Edge. — The Middle of each of these Cartilages is broad, and the Ends of them turn narrower and thinner, as they approach the middle Protuberance of the *Tibia*. — The thick convex Edge of each Cartilage is connected to the capsular and other Ligaments of the Articulation, but so near to their Rise from the *Tibia*, that the Cartilages are not allowed to change Places far; while the narrow Ends of the Cartilages becoming almost Ligaments, are fixed at the Insertion of the strong cross Ligament into the *Tibia*, and seem to have their Substance united with it; therefore a circular Hole is left between each Cartilage and the Ligament, in which the most prominent convex Part of each *Condyle* of the Thigh-bone moves. — The Circumference of these Cavities is rough and unequal for the firm Connexion of the Ligaments of the Joint. — Immediately below the Edge at its Back-part, two rough flatted Protuberances stand out: Into the internal, the Tendon of the *semimembranosus* Muscle is inserted; and a Part of the cross Ligament is fixed to the external. — On the Outside of this last Tubercle, a smooth slightly-hollowed Surface is formed by the Action of the *Popliteus* Muscle.

Below

Below the Fore-part of the upper End of the *Tibia*, a considerable rough Protuberance † rises, to which the strong tendinous Ligament of the *Rotula* is fixed.— On the internal Side of this, there is a broad scabrous slightly-hollowed Surface, to which the internal long Ligament of the Joint, the *Aponeurosis* of the *Vastus internus*, and the Tendons of the *Seminervosus*, *Gracilis* and *Sartorius*, are fixed.— The lowest Part of this Surface is therefore the Place where the *Tibia* ought to be sawed through in an Amputation, so as not to have too long and troublesome a Stump, and, at the same time, to preserve its Motions, by saving the proper Muscles.— Below the external Edge of the upper End of the *Tibia*, there is a circular flat Surface covered in a recent Subject with Cartilage, for the Articulation of the *Fibula*;— between which and the anterior Knob, there is a rough Hollow from which the *Tibialis anticus*, and *Extensor digitorum longus*, take their Origin.— From the smooth flat Surface, a Ridge runs obliquely downwards and inwards, to give Rise to Part of the *Solæus*, *Tibialis posticus*, and *Flexor digitorum longus*, and Insertion to the *Aponeurosis* of the *Semimembranosus* which covers the *Poplitæus*, and to some of the external Fibres of this last named Muscle.— At the Inside of this Ridge, an oblique plain Surface is left, where the greater Part of the *Musculus Poplitæus* is inserted.— The remaining

† Ἀντίκνῆστις, Anterior Tuber.

remaining Body of the *Tibia* is triangular.—The anterior Angle is very sharp, and is commonly called the *Spine* or *Shin* †. This Ridge is not streight; but turns first inwards, then outwards, and lastly inwards again.—The plain internal Side is smooth and equal, being little subjected to the Actions of Muscles; but the external Side is hollowed above by the *Tibialis anticus*, and below by the *Extensor digitorum longus* and *Extensor pollicis longus*.—The two Angles behind these Sides are rounded by the Action of the Muscles;—the posterior Side comprehended between them, is not so broad as those already mentioned, but is more oblique and flatted by the Action of the *Tibialis posticus* and *Flexor digitorum longus*.—Some Way above the Middle of the Bone, the internal Angle terminates, and the Bone is made round by the Pressure of the *Musculus solæus*.—Near to this, the Passage of the medullary Vessels is seen slanting obliquely downwards.

The lower End of the *Tibia* is made hollow, but so as a small Protuberance rises in the Middle.—The internal Side of this Cavity, which is smooth, and, in a recent Subject, is covered with Cartilage, is produced into a considerable Process, commonly named *Malleolus internus* †; the Point of which is divided by a Notch, and from it Ligaments are sent out to the Foot.—

We

† Ἀκάνθα, Spina, crea, linea prima tibiæ, angulus acutus.

† Ἐνυπόδιον, πύλον, Talus, clavicula, clavilla interior, cavilla domestica.

We ought to observe here, that this internal *Malleolus* is situated more forewards than the internal Condyle of the upper End of this Bone; which is necessary to be remembered in reducing a Fracture of the Leg (a).—The external Side of this End of the *Tibia* has a rough irregular semilunar Cavity formed in it, for receiving the lower End of the *Fibula*.—The posterior Side has two lateral Grooves, and a small middle Protuberance. In the internal Depression, the Tendons of the *Musculus Tibialis posticus* and *Flexor digitorum longus* are lodged; and in the external, the Tendon of the *Flexor longus pollicis* plays.—From the middle Protuberance, ligamentous Sheaths go out, for tying down these Tendons.

The Articulations and Motions of the *Tibia* shall be explained, after all the three Bones of the Leg are described.

Both the Ends of the *Tibia* are Cartilages at the Birth, and become afterwards *Epiphyses*.

FIBULA * is the small long Bone, placed on the Outside of the Leg, opposite to the external Angle of the *Tibia*; the Shape of it is irregularly triangular.

The Head of the *Fibula* has a superficial circular Cavity formed on its Inside, which, in a recent Subject, is covered with a Cartilage,

(a) *Winslow*, Exposition Anatomique, des Os secs, Sect. 865.

* Παράννημιον, perone, Focile minus, arundo minor, canna minor cruris, fura, radius.

lage, but so closely connected to the *Tibia* by Ligaments, as to allow only a small Motion backwards and forwards.—This Head is protuberant and rough on its Outside, where a strong round Ligament and the *Musculus Biceps* are inserted; and, below the Back-part of its internal Side, a Tubercle may be remarked, that gives Rise to the strong tendinous Part of the *Soleus* Muscle.

The Body of this Bone is a little crooked inwards and backwards, which Figure is owing to the Actions of the Muscles; but is still further increased by Nurses, who often hold Children carelessly by the Legs.—The sharpest Angle of the *Fibula* is forward, on each Side of which, the Bone is considerably, but unequally depressed by the Bellies of the several Muscles that rise from, or act upon it; and, in old People, these Muscles make distinct Sinuosities for themselves.—The external Surface of the *Fibula* is depressed obliquely from above downwards and backwards, by the two *Peronæi*.—Its internal Surface is unequally divided into two narrow longitudinal Planes, by an oblique Ridge extended from the upper Part of the anterior Angle, to join in with the lower End of the internal Angle. To this Ridge the Ligament stretched between the two Bones of the Leg is connected.—The anterior of the two Planes is very narrow above, where the *Extensor longus digitorum* and *Extensor longus Pollicis* arise from it; but it is broader below, where it has the Print of the *Nonus Vesalii*.—The posterior

sterior Plane is broad and hollow, giving Origin to the larger Share of the *Tibialis posterior*.—The internal Angle of this Bone has a tendinous Membrane fixed to it, from which Fibres of the *Flexor digitorum longus* take their Rise.—The posterior Surface of the *Fibula* is the plainest and smoothest, but is made flat above by the *Soleus*, and is hollowed below by the *Flexor pollicis longus*.—In the Middle of this Surface the Canal for the medullary Vessels may be seen slanting downwards.

I have been particular in remarking the Entry and Direction of the medullary Vessels of the large Bones of the Extremities (a); because, in several chirurgical Cases, a Surgeon, who is ignorant of this, may do Mischief to his Patient. Thus, for Example, if these Vessels are opened very near to their Entry into the Bone, an obstinate Hæmorrhagy may ensue: For the Arteries being connected to the bony Passage, Styptics, and other like Corrugators, are vainly applied; compressing Instruments can do no Service, and Ligatures cannot be employed.—There seems to be a particular Design in the Contrivance of these Canals; those in the *Os humeri*, *Tibia*, and *Fibula*, running obliquely downwards from their external Entry; whereas in the *Radius*, *Ulna*, and *Os femoris*, they slant upwards, whereby the Arteries and Nerves which are sent into these three last Bones, must suffer a considerable Reflexion before they come at the *Cancelli*.

(a) *Havers*, Osteolog. nov. Disc. 1. p. 59.

Cancelli. The Reason of this Diversity may perhaps be, that the Arteries which are so small within the Bones as to have no strong contractile propelling Force in their Coats, and where they are not assisted by the Action of any moving neighbouring Organ, should have, at least in their Passage through the Bone, a favourable Descent for their Liquids: Which, it is evident, they have in the descending oblique Passages formed for them in the first Class of Bones, to wit, the *Os humeri*, *Tibia* and *Fibula*, which are generally depending; and they also most frequently acquire the like Advantage in the *Radius*, *Ulna*, and *Os femoris*, because the Hand, in the most natural Posture, is higher than the Elbow; and when we sit or lie, the lower End of the Thigh-bone comes to be at least as high raised as the upper. In standing and walking, or when the Arms are moved, the Blood must indeed ascend as it passes through the Bones of the Fore-arm and Thigh; but the Pressure of the Muscles, then in Action, on the Vessels, before they enter the Bones, is sufficient to compensate the Disadvantage of their Course. This Reasoning seems to be still enforced, by observing, that this Passage is always nearer the upper than the lower Ends of these Bones.

The lower End of the *Fibula* is extended into a spungy oblong Head, on the Inside of which is a convex, irregular, and frequently a scabrous Surface, that is received by the external Hollow of the *Tibia*, and so
C c firmly

firmly joined to it by a very thin intermediate Cartilage and strong Ligaments, that it scarce can move.—Below this, the *Fibula* is stretched out into a coronoid Process, that is smooth, covered with Cartilage on its internal Side, and is there contiguous to the Outside of the first Bone of the Foot, the *Astragalus*, to secure the Articulation. This Process, named *Malleolus externus*, being situated farther back than the internal *Malleolus*, and in an oblique Direction, obliges us naturally to turn the Fore-part of the Foot outwards(a). At the lower internal Part of this Process, a spongy Cavity for mucilaginous Glands may be remarked; from its Point Ligaments are extended to the *Astragalus*, *Os Calcis*, and *Os Naviculare*, Bones of the Foot; and from its Inside short strong ones go out to the *Astragalus*. On the Back-part of it a Sinuosity is made by the Tendons of the *Peronæi* Muscles.—When the Ligament extended over these Tendons from the one Side of the Depression to the other is broke, stretched too much, or made weak by a Strain, the Tendons frequently start forwards to the Outside of the *Fibula*.

The Conjunction of the upper End of the *Fibula* with the *Tibia* is by *Arthrodia*; and at its lower End the Cartilage seems to glue the two Bones together, not, however, so firmly in young People, but that the Motion at the other End of such a long *Radius* is very observable.—In old Subjects I of-

ten

(a) *Winslow*, Memoires de l'Acad. des Sciences, 1722.

ten see the two Bones of the Leg grown together at their lower Ends.

The principal Use of this Bone is to afford Origin and Insertion to Muscles; the Direction of which may be a little altered on proper Occasions, by its upper Part shuffling backwards and forwards.—It likewise helps to make the Articulation of the Foot more secure and firm.—The Ends of the *Tibia* and *Fibula* being larger than their Middle, a Space is here left, which is filled up with such another Ligament as I described extended between the Bones of the Fore-arm; and which is also discontinued at its upper Part, where the *Tibialis anticus* immediately adheres to the *Soleus* and *Tibialis posticus*; but every where else it gives Origin to muscular Fibres (a).

Both the Ends of this Bone are cartilaginous in a ripe Child, and assume the Form of *Appendices* before they are united to its Body.

*ROTULA** is the small flat Bone situated at the Fore-part of the Joint of the Knee.—Its Shape resembles the common Figure of the Heart with its Point downwards.—The anterior convex Surface of the *Rotula* is pierced by a great Number of Holes, into which Fibres of the strong Ligament that is spread over it enter.—Behind, its Surface is smooth, covered with Cartilage, and divided by a middle convex Ridge into two Cavities, of which the external

C c 2

ternal

(a) *Weithrecht. Syndesimolog. p. 156.*

* Ἐπιμυλῖς, μυλακρίς, κόγχος, ἐπιγονατῖς, πλανησιέδρον.
patella, mola, genu, scuti-forme os, cartilaginofum, disci-
forme, oculus genu.

ternal is largest; and both are exactly adapted to the Pulley of the *Os femoris*, on which they are placed in the most ordinary unstraining Postures of the Leg; but when the Leg is much bended, the *Rotula* descends far down on the Condyles; and when the Leg is fully extended, the *Rotula* rises higher, in its upper Part, than the Pulley of the Thigh-bone.—The plain smooth Surface is surrounded by a rough prominent Edge, to which the capsular Ligament adheres:—Below, the Point of the Bone is scabrous, where the strong tendinous Ligament from the Tubercle of the *Tibia* is fixed.—The upper horizontal Part of this Bone is flatted and unequal, where the Tendons of the Extensors of the Leg are inserted.

The Substance of the *Rotula* is cellular, with very thin external firm Plates: But then these *Cellulæ* are so small, and such a Quantity of Bone is employed in their Formation, that scarce any Bone of its Bulk is so strong. Besides, it is covered all over with a thick Ligament, (as it was observed, that this Sort of Bones generally is), to connect its Substance, and is moveable to one Side or other; therefore is sufficiently strong to resist the ordinary Actions of the large Muscles that are inserted into it, or any common external Force applied to it; while a fixed Process, such as the *Olecranon*, would not have been sufficient to bear the whole Weight of our Bodies, which frequently fall on it, and would have hindered the rotatory Motion of the Leg. Notwithstanding

standing these Precautions to preserve this Bone from such Injuries, yet I have seen a transverse Fracture in it, when, by the Report of the Patient, and of the People about him, and by the Want of Swelling, Discolouring, or other Mark of Bruise or Contusion, it was plain the Bone was broken by the violent straining Effort of the Muscles (a). Though my Patient recovered the Use of the Joint of the Knee, yet I think it reasonable to believe, that this Sort of Fracture is commonly attended with Difficulty of Motion, after the broken Parts of the *Rotula* are reunited, because the callous Matter probably extends itself into the Cavity of the Joint, where it either grows to some of the Parts, or makes such an Inequality on the Surface of this Bone, as does not allow it to perform the necessary Motions on the Condyles of the *Femur* (b).

The Articulation of the *Rotula* with the *Os femoris* is a plain *Ginglimus*; and it is connected to the *Tibia* by *Syndesmosis*.

At the ordinary Time of Birth, the *Rotula* is entirely cartilaginous, and scarcely assumes a bony Nature so soon as most *Epiphyses* do.

The Parts which constitute the Joint of the Knee being now described, let us examine what are its Motions, and how performed.—The two principal Motions are Flexion and Extension.—In the former of these, the Leg may be brought to a very acute Angle with the Thigh, by the

C c 3

Condyles

(a) See *Ruysh. Observ. Anat. Chirurg. Obs. 3.*

(b) *Parv. Liv. 15. cap. 22.*

Condyles of the Thigh-bones being round and made smooth so far backwards. In performing this, the *Rotula* is pulled down by the *Tibia*.—When the Leg is to be extended, the *Rotula* is drawn upwards, and consequently the *Tibia* forwards, by the *Extensor* Muscles; which, by means of the protuberant Joint, and of this thick Bone with its Ligament, have in effect the Chord, with which they act, fixed to the *Tibia* at a considerable Angle, therefore act with Advantage; but are restrained from pulling the Leg farther than to a straight Line with the Thigh, by the posterior Part of the *cross* Ligament, that the Body might be supported by a firm perpendicular Column: For at this Time the Thigh and Leg are as little moveable, as if they were one continued Bone. — But when the Joint is a little bended, the *Rotula* is not tightly braced, and the posterior Ligament is relaxed; therefore this Bone may be moved a little to either Side, or with a small Rotation in the superficial Cavities of the *Tibia*; which is done by the Motion of the external Cavity backwards and forwards, the internal serving as a sort of Axis (*a*). Seeing then one Part of the *cross* Ligament is situated perpendicularly, and the posterior Part is stretched obliquely from the internal Condyle of the Thigh outwards, that posterior Part of the *cross* Ligament prevents the Leg's being turned at all inwards; but it could

(*a*) *Winflow*, Exposition Anatomique du corps humain traité des Os secs, § 976.

could not hinder it from turning outwards almost round, was not that Motion confined by the lateral Ligaments of this Joint, which can yield little. This Rotation of the Leg outwards, is of good Advantage to us in crossing our Legs, and turning our Feet outwards, on several necessary Occasions; though it is altogether fit this Motion should not be very large, lest Luxations should frequently have happened here.— While all these Motions are performing, the Part of the *Tibia* that moves immediately on the Condyles is only so much as is within the cartilaginous Rings, which, by the Thickness on their Outfides, make the Cavities of the *Tibia* more horizontal, by raising their external Side where the Surface of the *Tibia* slants downwards. By this Means the Motions of this Joint are more equal and steady than otherwise they would have been. The Cartilages being capable of changing a little their Situation, are fit for doing this good Office in the different Motions and Postures of the Member, and likewise contribute to make the Motions larger and quicker.

On account of the very large Surface of the Bones forming the Joint of the Knee, and the many strong Ligaments connecting them, Luxations seldom happen here. But these very Ligaments, the *Aponeuroses* passing over this Joint, the Quantity of Fat and mucaginous Glands necessary for lubricating it, make it more subject to *White-swelling*s,

swellings, Dropsies, and such other Disorders, than any other Joint of the Body.

The *FOOT* is divided, as well as the Hand, into three Parts, viz. *Tarsus*, *Metatarsus*, and *Toes*: In the Description of which, the several Surfaces shall be named, according to their natural Situation, viz. the *Broad* of the Foot, shall be called superior; the *Sole*, inferior; the Side on which the Great-toe is, internal; that where the Little-toe is, external.

The *Tarsus* * consists of seven spungy Bones; to wit, the *Astragalus*, *Os calcis*, *Naviculare*, *Cuboides*, *Cuneiforme externum*, *Cuneiforme medium*, and *Cuneiforme internum*.

The *Astragalus* is the uppermost of these Bones.—The *Os calcis* is below the *Astragalus*, and is considerably prominent backwards beyond the other Bones of the *Tarsus*, to form the Heel.—The *Os naviculare* is in the Middle of the internal Side of the *Tarsus*.—The *Os cuboides* is the most external of the Row of four Bones at the Fore-part of the *Tarsus*.—The *Os cuneiforme externum* is placed at the Inside of the *Cuboid*.—The *Cuneiforme medium* is between the *external* and *internal cuneiform* Bones, and the *internal Cuneiform* is put at the internal Side of the Foot.

That the Description of these Bones may not be immoderately swelled with Repetitions, I desire, once for all, to observe, That where-ever a Ridge is mentioned, without

* *Rassetta*.

a particular Use assigned, a Ligament is understood to be fixed to it; or where a spongy rough Cavity, Depression or *Fossa* is remarked, without naming its Use, a Ligament is inserted, and mucilaginous Glands are lodged: For such will occur in the Detail of each of these Bones.

The upper Part of the *Astragalus* † is formed into a large smooth Head ‡, which is slightly hollowed in the Middle; and therefore resembles a superficial Pulley, by which it is fitted to the lower End of the *Tibia*.—The internal Side of this Head is flat and smooth, to play on the internal *Malleolus*.—The external Side has also such a Surface, but larger, for its Articulation with the external *Malleolus*.—Round the Base of this Head there is a rough *Fossa*; and, immediately before the Head, as also below its internal smooth Surface, we find a considerable rough Cavity.

The lower Surface of the *Astragalus* is divided by an irregular deep rough *Fossa*; which at its internal End is narrow, but gradually widens, as it stretches obliquely outwards and forwards.—The smooth Surface, covered with Cartilage, behind this *Fossa*, is large, oblong, extended in the same oblique Situation with the *Fossa*, and concave, for its Conjunction with the *Os calcis*.—The Back-part of the Edge of this Cavity is produced into two sharp-pointed rough Processes,

† "Ἀστράγος; Talus, balistæ os, malleolus, chaib, quatrio, Os tellaræ, claviculæ, nuciforme.

‡ Τετραπύρος.

cesses, between which is a Depression made by the Tendon of the *Flexor pollicis longus*. —The lower Surface before the *Fossa* is convex, and composed of three distinct smooth Planes. The long one behind, and the exterior or shortest, are articulated with the Heel-bone; while the internal, which is the most convex of the three, rests and moves upon a cartilaginous Ligament, that is continued from the *Calcaneum* to the *Os scaphoides*. Without which Ligament the *Astragalus* could not be sustained, but would be pressed out of its Place by the great Weight it supports, and the other Bones of the *Tarsus* would be separated. Nor would a Bone be fit here, because it must have been thicker than could conveniently be allowed; otherwise it would break, and would not prove such an easy bending Base, to lessen the Shock which is given to the Body in leaping, running, &c.

The Fore-part of this Bone is formed into a convex oblong smooth Head, called by some its Process, which is received by the *Os naviculare*. —Round the Root of this Head, especially on the upper Surface, a rough *Fossa* may be remarked.

The *Astragalus* is articulated above to the *Tibia* and *Fibula*, which together form one Cavity. Though this Articulation is a *Ginglimus*, it is however so loose, and the Prominencies and Cavities are so small, as to allow Motions in all Directions. The Flexion and Extension are the most considerable, the other Motions being confined by

by the *Malleoli*, and by the strong Ligaments which go out from the Points of these Processes to the *Astragalus* and *Os calcis*. When the Foot is bended, so far as it is commonly when we stand, no lateral or rotatory Motion is allowed in this Joint; for then the Head of the *Astragalus* is sunk deep between the *Malleoli*, and the Ligaments are tense; but when the Foot is extended, the *Astragalus* can move to either Side, and with a small Rotation. By this Contrivance the Foot is firm, when the Weight of the Body is to be supported on it; and when a Foot is raised, we are at Liberty to direct it more exactly to the Place we intend next to step upon.—The *Astragalus* is joined, below, to the *Os calcis*, by the third Species of *Ginglimus*; and before, to the *Os naviculare*, by *Enarthrosis*.

A considerable Share of this Bone is ossified in a new-born Infant.

Calcaneum * is the largest bone of the seven.—Behind, it is formed into a large Knob, commonly called the *Heel*: The Surface of which is rough behind, where the *Tendo Achillis* is inserted into it; and above, it is hollow and spungy. Farther forwards, on the upper Surface of the *Calcaneum*, there is an irregular oblong smooth Convexity, adapted to the Concavity at the Back-part of the *Astragalus*: And beyond this a narrow *Fossa* is seen, which divides it from two small concave smooth Surfaces, that are joined to the Fore-part of the *Astragalus*,

* *Os calcis*, πτέρνα, calcar pedis.

astragalus.—Behind the posterior of these smooth Surfaces, which is the largest, a small Sinuosity is made by the Tendon of the *Flexor digitorum longus*; at the Fore-part of which a small rough Protuberance appears, that gives Rise to the *Musculus extensor digitorum brevis*,

The external Side of this Bone is flat, with a superficial *Fossa* running horizontally, in which the Tendon of the *Musculus peroneus longus* is lodged.—The internal Side of the Heel-bone is hollowed, for lodging the Origin of the *Massa carnea Jac. Sylvii*, and for the safe Passage of Tendons, Nerves, and Arteries.—Under the Side of the internal smooth Concavity, a particular Groove is made by the Tendon of the *Flexor pollicis longus*; and from the thin Protuberance on this internal Side, the cartilaginous Ligament that supports the *Astragalus*, goes out to the *Os naviculare*; on which Ligament, and on the Edge of this Bone to which it is fixed, the Groove is formed for the Tendon of the *Flexor digitorum profundus*.

The lower Surface of this Bone is pressed flat at the Back-part, by the Weight of our Bodies; and, immediately before this Plane, there are two Tubercles, from the internal of which the *Musculus abductor pollicis*, *Flexor digitorum sublimis*, as also part of the *Aponeurosis plantaris*, and of the *Abductor minimi digiti*, have their Origin; and the other Part of the *Abductor minimi digiti* and *Aponeurosis plantaris* rises from the external.

—Before these Protuberances this Bone

is

is concave, for lodging the Flexor-muscles; and at its Fore-part we may observe a rough Depression, from which, and a Tubercle behind it, the Ligament goes out that prevents this Bone to be separated from the *Os Cuboides*.

The Fore-part of the *Os calcis* is formed into an oblong Pulley-like smooth Surface, which is circular at its upper external End, but is pointed below. This smooth Surface is fitted to the *Os cuboides*.

A large Share of the Heel-bone is ossified at the ordinary Time of Birth, and the large Knob appears afterwards in Form of an *Epiphyse*.

Os naviculare †, is somewhat circular.—It is formed into an oblong Concavity behind, for receiving the anterior Head of the *Astragalus*.—On the upper Surface there is a rough *Fossa*.—Below, the *Os naviculare* is very unequal and rough; but hollow for the Safety of the Muscles.—On its Inside a large Knob rises out, from which the *Abductor pollicis* takes in part its Origin, and the Tendon of the *Tibialis posticus* is inserted into it: And to it two remarkable Ligaments are fixed; the first is the strong one, formerly mentioned, which supports the *Astragalus*; the second is stretched from this Bone obliquely cross the Foot, to the metatarsal Bones of the middle Toe, and of the Toe next to the little one.—On the Outside of the *Os naviculare* there is a semi-circular smooth Surface, where it is joined

D d

to

† Σκαφοειδής, *Os cymbæ*.

to the *Os cuboides*—The Fore-part of this Bone is all covered with Cartilage, and is divided into three smooth Planes, fitted to the three *Ossa cuneiformia*.

The *Os naviculare* is wholly cartilaginous in a new-born Infant.

OS CUBOIDES † is a very irregular Cube.—Behind, it is formed into an oblong unequal Concavity, adapted to the Fore-part of the *Os calcis*.—On its internal Side, there is a small semicircular smooth Cavity, to join the *Os naviculare*; immediately before which, an oblong smooth Plane is made by the *Os cuneiforme externum*:—Below this, the Bone is hollow and rough.—On the internal Side of the lower Surface, a round Protuberance and *Fossa* are found, where the *Musculus adductor pollicis* has its Origin. On the external Side of this same Surface, there is a round Knob, covered with a Cartilage; immediately before which, a smooth *Fossa* may be observed, in which the Tendon of the *Peronæus primus* runs obliquely cross the Foot; and on the Knob, the thin flat Cartilage proper to this Muscle plays; in place of which sometimes a Bone is found:—More externally than the Knob, a rough Hollow is made, for the strong Ligament stretched betwixt this Bone and the *Os calcis*.—Before, the Surface of the *Os cuboides* is flat, smooth, and slightly divided into two Planes, for sustaining the *Os metatarsi* of the little Toe, and of the Toe next to it.

The

† Πολύμορφον, cubiforme, quadratum, grandinosum, varium, tessaræ, multiforme.

The Ossification of this Bone is scarcely begun at the Birth.

Os cuneiforme externum *, if we regard its Situation or *medium* by its Bulk, is much of the Shape of a Wedge, being broad and flat above, with long Sides running obliquely downwards, and terminating in a sharp Edge.—The upper Surface of this Bone is an oblong Square.—The one behind is nearly a Triangle, but not compleat at the inferior Angle, and is joined to the *Os naviculare*.—The external Side is an oblong Square divided as it were by a Diagonal; the upper Half of it is smooth, for its Conjunction with the *Os cuboides*: The other is a scabrous Hollow, and in its superior anterior Angle a small smooth Impression is made by the *Os metatarsi* of the Toe next to the Little one.—The internal Side of this Bone is also quadrangular, with the Fore-part of its Edge made flat and smooth by the *Os metatarsi* of the Toe next to the Great one, and the Back-part is also flat and smooth where the *Os cuneiforme medium* is contiguous to it.—The Fore-part of this Bone is an oblong Triangle, for sustaining the *Os metatarsi* of the middle Toe.

Os cuneiforme medium, or *minimum*, is still more exactly the Shape of a Wedge than the former.—Its upper Part is square; — its internal Side has a flat smooth Surface above and behind, for its Conjunction with the following Bone; with a small rough *Fossa*

D d 2

sa

* Chalcoideum externum.

sa below; and a considerable Share of it is rough and hollow.—The external Side is smooth and a little hollowed, where it is contiguous to the last described Bone.—Behind, this Bone is triangular, where it is articulated with the *Os naviculare*; and it is also triangular at its Fore-part, where it is contiguous to the *Os metatarsi* of the Toe next to the Great one.

Os cuneiforme maximum, or *internum*, differs from the two former in its Situation, which is more oblique than their's.—Besides, its broad thick Part is placed below, and the small thin Point is above and outwards; while its under broad Surface is concave, for allowing a safe Passage to the Flexors of the great Toe.—The Surface of this *Os cuneiforme* behind, where it is joined to the *Os naviculare*, is hollow, smooth, and of a circular Figure below, but pointed above.—The external Side consists of two smooth and flat Surfaces, whose Direction is nearly at right Angles with each other. With the posterior, that runs obliquely from below forwards and upwards, the *Os cuneiforme minimum* is joined; and with the anterior, whose Direction is longitudinal, the *Os metatarsi* of the Toe next to the Great one is connected. — The Fore-part of this Bone is semilunar, but flat and smooth, for sustaining the *Os metatarsi* of the great Toe.—The internal Side is scabrous, with two remarkable Tubercles below, from which the *Musculus abductor pollicis* rises; and

and the *Tibialis anticus* is inserted into its upper Part.

The three cuneiform Bones are all in a cartilaginous State in a *Fœtus* of nine Months.

These seven Bones of the *Tarsus*, when joined, are convex above, and leave a Concavity below, for lodging safely the several Muscles, Tendons, and Vessels that lie in the Sole of the Foot.—In the recent Subject, their upper and lower Surfaces are covered with strong Ligaments, which adhere firmly to them, and all the Bones are so tightly connected by these and the other Ligaments, which are fixed to the rough Ridges and *Fossæ* mentioned in the preceeding Description of the particular Bones, that, notwithstanding the many Surfaces covered with Cartilage, some of which are of the Form of the very moveable Articulations, no more Motion is here allowed, than only to prevent too great a Shock of the Fabrick of the Body, in walking, leaping, &c. by falling on too solid a Base; which, if it was one continued Bone, would likewise be much more liable to be broken; and, in order to make our Foot accommodate itself to the Surfaces we tread on, by becoming more or less hollow, or by raising or depressing either Side of it.—When the Ligaments are too weak, as in some morbid Cases, a very evident Motion of the *Os naviculare* on the *Astragalus* may be observed.—Sprains here occasion, as in the Wrist, great Pain and obstinate Tumors, which too often cause carious Bones.

METATARSUS * is composed of five Bones, which, in their general Characters, agree with the metacarpal Bones; but may be distinguished from them by the following Marks: 1. They are longer, thicker, and stronger. 2. Their anterior round Ends are not so broad, and are less in proportion to their Bases. 3. Their Bodies are sharper above, and flatter on the Sides, with their inferior Ridge inclined more to the Outside. 4. The Tubercles at the lower Parts of the round Heads are larger.

The first or internal metatarsal Bone is easily distinguished from the rest by its Thickness.—The one next to it is the longest, and with its sharp Edges almost perpendicular.—The others are shorter and more oblique, as their Situation is more external. Which general Remarks, with the Description I am now to give of each, may teach us to distinguish them from each other.

Os metatarsi pollicis is by far the thickest and strongest, as having much the greatest Weight to sustain. Its Base is oblong, irregularly concave, and of a semilunar Figure, to be adapted to the *Os cuneiforme maximum*.—The inferior Edge of this Base is a little prominent and rough, where the Tendon of the *Peronæus primus* Muscle is inserted.—On its Outside an oblique circular Depression is made by the second metatarsal Bone.—Its round Head has generally on

* *Στῆθος, πῆδον*, Planta, planum, vestigium, solium, pectus, præcordium, pectusculum.

on its Fore-part a middle Ridge, and two oblong Cavities, for the *Ossa sesamoidea*; and on the external Side a Depression is made by the following Bone.

Os metatarsi of the second Toe, is the longest of the five, with a triangular Base supported by the *Os cuneiforme medium*, and the external Side produced into a Process; the End of which is an oblique smooth Plane, joined to the *Os cuneiforme externum*.—Near the internal Edge of the Base, this Bone has two small Depressions, made by the *Os cuneiforme maximum*, between which is a rough Cavity.—Farther forwards we may observe a smooth Protuberance, which is joined to the foregoing Bone.—On the Outside of the Base are two oblong smooth Surfaces, for its Articulation with the following Bone; the superior smooth Surface being extended longitudinally, and the inferior perpendicularly; between which there is a rough *Fossa*.

Os metatarsi of the middle Toe, is the second in Length.—Its Base, supported by the *Os cuneiforme externum*, is triangular, but slanting outwards, where it ends in a sharp-pointed little Process; and the Angle below is not completed.

The internal Side of this Base is adapted to the preceeding Bone; and the external Side has also two smooth Surfaces covered with Cartilage, but of a different Figure; for the upper one is concave, and, being round behind, turns smaller as it advances forwards; and the lower Surface is little, smooth,

smooth, convex, and very near the Edge of the Base.

Os metatarsi of the fourth Toe, is near as long as the former, with a triangular slanting Base joined to the *Os cuboides*, and made round at its external Angle, having one hollow smooth Surface on the Outside, where it is pressed upon by the following Bone, and two on the internal Side, corresponding to the former Bone; behind which is a long narrow Surface impressed by the *Os cuneiforme externum*.

Os metatarsi of the little Toe, is the shortest, situated with its two flat Sides above and below, and with the Ridges laterally.—The Base of it, Part of which rests on the *Os cuboides*, is very large, tuberos, and produced into a long-pointed Process externally, where Part of the *Abductor minimi digiti* is fixed; and into its upper Part the *Peronæus secundus* is inserted.—Its Inside has a flat conoidal Surface, where it is contiguous to the preceeding Bone.

When we stand, the fore Ends of these metatarsal Bones, and the *Os calcis*, are our only Supporters; and therefore it is necessary they should be strong, and should have a confined Motion.

The Bones of the *TOES* are much a-kin to those of the Thumb and Fingers: Particularly the two of the great Toe are precisely formed as the two last of the Thumb; only their Position, in respect of the other Toes, is not oblique; and they are proportionally much stronger, because they are sub-
jected

jected to a greater Force; for they sustain the Force with which our Bodies are pushed forwards by the Foot behind at every Step we make; and on them principally the Weight of the Body is supported, when we are raised on our Tip-toes.

The three Bones in each of the other four Toes, compared to those of the Fingers, differ from them in these Particulars.—They are less, and smaller in proportion to their Lengths:—Their Bases are much larger than their anterior Ends:—Their Bodies are sharper above and below, and flatter on the Sides.—The first *Phalanx* is proportionally much longer than the Bones of the second and third, which are very short.

Of the four, the Toe next to the Great one, has the largest Bones in all Dimensions, and more externally the Toes are less.—The little Toe, and frequently that next to it, have the second and third Bones intimately united into one; which may be owing to their little Motion, and the great Pressure they are subjected to.

The Toes are of good Use to us in walking; for, when the Sole is raised, they bring our Body, with its Center of Gravity, perpendicular to the advanced Foot.

The Bones of the *Metatarsus* and Toes, are in the same Condition in Children as those of the *Metacarpus* and Fingers.

The only Bones now remaining to complete the Description of the Skeleton, are the small ones, which are found at the Joints
of

of the Fingers and Toes, and in some other Parts, called,

OSSA SESAMOIDEA, which are of very different Figures and Sizes, though they are generally said to resemble the Seed of the *Sesamum*.—They seem to me nothing else than the Ligaments of the Articulations or the firm Tendons of strong Muscles, or both, become bony, by the violent Compression which they suffer. Thus the *sesamoid* Bones at the Beginning of the *Gastrocnemii* Muscles, are evidently composed of the tendinous Fibres only.—These, at the first Joint of the great Toe are as plainly the same continued Substance with the Ligaments and the Tendons of the *Abductor*, *Flexor brevis*, and *Adductor*.—That which is sometimes double at the second Joint of that Toe, is Part of the capsular Ligament; and if we enumerate the other *sesamoid* Bones that are at any time found, we may observe all of them formed in this Manner.—Their Number, Figure, Situation, and Magnitude, are so uncertain, that it were in vain to insist on the Differences of each; and therefore I shall only in general remark,

1. That where-ever the Tendons and Ligaments are firmest, the Actions of the Muscles strongest, and the Compression greatest, there such Bones are most commonly found.

2. That, *cæteris paribus*, the older the Subject is in which they are sought, their Number is greater, and their Size is bigger.

3. The

3. The more Labour any Person is insured to, he has, *cæteris paribus*, the most numerous and largest *Ossa sesamoidea*.

However, as the two at the first Joint of the great Toe are much larger than any other, and are seldom wanting in an Adult, we may judge, that besides the more forcible Cause of their Formation, there should also be some particular Advantage necessary at this Place, rather than elsewhere, which may possibly be, to allow the *Flexor* Muscles to send their Tendons along this Joint, secure from Compression in the Hollow between the two oblong sesamoid Bones; while, by removing these Tendons from the Center of Motion, and giving them the Advantage of an Angle at their Insertion, the Force of the Muscles is increased, and therefore the great superincumbent Weight of our Body in Progression is more easily raised.

A P P E N-

APPENDIX

OF THE MANKY OF THE SKIN

TO finish the Description of the Bones
A is generally to conclude the Chapter
but, that no Part of the subject may
be left unexplained, I think it necessary to
mention the different Marks of the Male
and Female Sexes; and have chosen to
insert them in the latter Part of the
Chapter, having a more distinct Connection
with the preceding, and following
in their tender Years, till they have
attained Strength and Firmness to bear the
Influence of the Atmosphere, and Contact of
the more solid Substances, their Bodies are
naturally imperfect, and devoid of a Male
and some Parts of the Body different from
those of the robust Male; which agree to
the Description already given, and is what
the proper Specimens of the Female were
particularly remarked, which could not be
done in all Places where they occur, with-
out perplexing the Order of this Treatise.
Therefore I chose rather to insert them up

A P P E N D I X.

Of the Marks of a FEMALE SKELETON.

TO finish the Description of the Bones, is generally to conclude the *Osteology*; but, that no Part of the Subject may be left untouched, I think it necessary to subjoin the distinguishing Marks of the Male and Female Skeletons; and have chosen to illustrate them in the latter; because Women having a more delicate Constitution, and affording Lodging and Nourishment to their tender *Fœtuses*, till they have sufficient Strength and Firmness to bear the Injuries of the Atmosphere, and Contact of other more solid Substances, their Bones are frequently incomplete, and always of a Make in some Parts of the Body different from those of the robust Male; which agree to the Description already given, unless where the proper Specialities of the Female were particularly remarked; which could not be done in all Places where they occur, without perplexing the Order of this Treatise: Therefore I chose rather to sum them up here by Way of *Appendix*.

E e

The

The Causes of the following Specialities of the female Bones, may be reduced to these three. 1. A weak lax Constitution. 2. A sedentary unactive Life, increasing that Constitution. 3. A proper Frame for being mothers.

The Bones of Women are smaller in proportion to their Length than those of Men; because the Force of their Muscles is not so great, nor is such strong external Force applied to them to prevent their stretching out in Length.

The Depressions, Ridges, scabrous Surfaces, and other Inequalities made by the Muscles, are not so conspicuous in them; because their Muscles are neither so thick nor strong, nor so much employed, to make so strong Prints on their Bones.

Their *Os frontis* is more frequently divided by a Continuation of the *sagittal* Suture, which depends on the first and second general Causes assigned above, for the Specialities in their Bones; as will appear after reflecting on the Account given formerly of the middle internal Spine of this Bone.

Their *Clavicles* are less crooked; because their Arms have been less forcibly pulled forwards, which in our *European* Women, especially those of Distinction, is more hindered by their Garb.

Their *Sternum* is more raised by long Cartilages below, that the *Thorax* might be there widened in some Proportion to what it is shortened by the Pressure upon the *Diaphragm*, when they are with Child.

The

The Defect of Bone, or the Hole in the Middle of the *Sternum*, is ofteneft found in them, to allow the Passage of the mammary Veffels, fay fome ; but, in my Opinion, this is owing to a lax Constitution, by which the Offification is not fo foon completed as in Men, where the Action of the Solids is vigorous, and the Circulation of the Fluids is brisk ; for a much fmallier Hole might have ferved this Purpose ; and the Branches of the internal mammary Veffels which are fent to the external Parts of the *Thorax*, pafs out between the Cartilages of the Ribs, before thefe are joined to the *Sternum*.

The *Cartilago Xiphoides*, is oftener bifurcated in Women than Men, for the Reason affigned in the preceeding Paragraph, viz. a lefs forcible Power of Offification.

The fuperior Cartilages of the Ribs fooner offify, to fupport the Weight of the *mammæ*.

The middle Cartilages are more flat and broad by the Weight of the Breasts.

The inferior Cartilages are longer, for enlarging the Chest.

Weak Women who have born many Children when young, often have the *Vertebrae* of their back bended forwards, and their *Sternum* depressed, or become round-shouldered and flat-breasted (a) by the Prefsure and Weight of the impregnated *Uterus*,

E e 2

and.

(a) *Chefelden Anatomy*, book 1. chap. 3.

and by the strong Action of the abdominal Muscles.

The *Os sacrum* is broader and turned more outwards, for enlarging the *Pelvis*.

The *Os Coccygis* is more moveable, and less bended forwards, to facilitate the Birth.

The *Ossa Ilium* are more hollow, and more reflected outwards, and consequently further removed from each other, in order to widen the lower Part of their *Abdomen*, and for the better Support of the impregnated *Uterus*.

The Ridge on the upper Part of the *Os Pubis* is larger in such Women as have born Children, being extended by the strong Action of the *Musculi recti abdominis*.

The Cartilage between the two *Ossa Pubis*, is thicker, by which the *Pelvis* is more capacious.

The conjoined Surfaces of the *Ossa Pubis*, and of the *Ossa innominata* and *sacrum* are less, that with the straighter *Os sacrum* a larger Passage might be left for the Exclusion of the Child in Birth.

The great Tuberosity of the *Ossa Ischiûm* is flatter in Women than in Men, because it is more pressed upon in the sedentary Life which Females enjoy.

In consequence of the *Pelvis* of Women being wider, the Articulations of their Thigh-bones must be farther removed from each other; and therefore a larger Space is left for the Procreation and Birth of Children (a); which Distance of the Thighs,
may

(a) *Albin. De Ossib. § 339.*

may be one Reason why Women in running generally shuffle more from one Side to the other than Men, to preserve the Center of Gravity of their Bodies from falling too far to a Side of the Joint of the Thigh that supports them when the other is raised, which would endanger their tumbling to the Ground.

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THE
ANATOMY

OF THE
HUMAN NERVES,

WITH

An Account of the reciprocal
Motions of the HEART,

AND

A Description of the HUMAN LAC-
TEAL SAC and DUCT.

The FIFTH Edition.

By ALEXANDER MONRO, *P. A.*

P R E F A C E.

BEing informed that the following Essays have been useful to the Students in Anatomy, I have caused them to be reprinted, with such Amendments as I thought necessary.

That Offence might not be given, I have treated all the Opinions concerning the disputed Physiology of the Nerves, with that Deference which the Uncertainty of the Subject required, and have not only concealed the Names of the Writers whose Sentiments were different from mine, but have shunned Quotations from those whom I approve, lest the Knowledge of the latter should be a Key to discover the former by.

Descriptions of the very minute Ramifications of the Nerves are obscure to the young Gentlemen for whose Use I write; and therefore I have taken notice only of the larger Branches in the Description of the particular Nerves.

I have endeavoured to illustrate my great Master, Dr. Boerhaave's Doctrine, in the Account here given of the Systole and Diastole of the Heart.

P R E F A C E.

The Description of the Receptaculum chyli and thoracic Duct is more accurate, than in the common Systems of Anatomy; and on that account is here republished.

The Corrections and Additions made in this Edition of the Anatomy of the Bones, and of these Essays, shew, that my own Errors and Omissions are rather too great a Burden for me to struggle with: It is cruel to load me with a great Number more; and many of them, such as the youngest Pupil under my Care would be ashamed of. I must therefore beg the Publick to impute no more Faults to me as an Author, than what are contained in the preceeding Anatomy of the Bones, in the following Essays, and in those Papers of the five Volumes of medical Essays and Observations to which my Name is prefixed.

T H E

THE
ANATOMY
OF THE
HUMAN NERVES.

Of the NERVES in general.

1. **B**Y the Assistance of Injections and Microscopes, wonderful Plexuses of Blood-vessels are discovered to go from the *Pia Mater*, into the *Cortex*, cineritious, or ashy-coloured Part of the *Cerebrum*, and *Cerebellum*, and *spinal Marrow*; whereas we can only see longitudinal Vessels, without numerous Ramifications or reticular Plexuses, in the white medullary Substance of these Parts.

2. The Continuity of the *Cortex* with the *Medulla* of the *Encephalon* and *spinal Marrow* is observable with the naked Eye, and is more distinctly seen with the Assistance of a Microscope.

3. In

3. In dissecting the *Brain* and *Cerebellum*, we see the small Beginnings of the *Medulla* proceeding from the *Cortex*, and can trace its gradual Increase by the Addition of more *Medulla* coming from the *Cortex*.

4. Both *Cortex* and *Medulla* are very succulent; for being exposed to the Air to dry, they lose more of their Weight than most other Parts of the Body do.

5. In several Places we can observe the *Medulla* to be composed of Fibres laid at each others Sides.

6. The medullary Substance is all employed in forming the white fibrous Gords, which have now the Name of *Nerves* appropriated to them. Within the Scull, we see the Nerves to be the medullary Substance continued; and the *Medulla spinalis* is all employed in forming Nerves.

7. The common Opinion concerning the Rise of the Nerves, founded on a superficial Inspection of those Parts, is, that the Nerves are propagated from that Side of the *Encephalon*, at which they go out of the Scull. But it having been remarked, after a more strict Inquiry, and preparing the Parts by Maceration in Water, that the medullary Fibres decussate or cross each other in some Parts of the *Medulla*; as for Example, at the *Corpus annulare*, and Beginning of the *Medulla spinalis*: And practical Observators having related several Examples of People whose Brain was hurt on one Side, while the Morbid Symptom, Palsy, appeared on the other Side of the Body,

dy, of which I have seen two Instances; and Experiments made on Brutes having confirmed these Observations, it has been thought, that the Nerves had their Rise from that Side of the *Encephalon*, which is opposite to their Egrefs from the Scull. It may however still be said, that this last Opinion is not fully demonstrated, because a Decussation in some Parts is not a Proof that it obtains universally; and if there are Examples of Palsy of the Side opposite to where the Lesion of the Brain was, there are also others, where the Injury done to the Brain and the Palsy were both on the same Side.

8. The Nerves are composed of a great many Threads lying parallel to each other at their Exit from the *Medulla*.

This fibrous Texture is evident at the Origin of most of the Nerves within the Scull; and in the *Cauda equina* of the *Medulla spinalis*, we can divide them into such small Threads, that a very good Eye can scarce perceive them; but these Threads, when looked at with a Microscope, appear each to be composed of a great Number of smaller Threads.

9. How small one of these Fibrils of the Nerves is, we know not; but when we consider that every, even the most minute Part of the Body is sensible, and that this must depend on the Nerves (which all conjoined, would not make a Cord of an Inch Diameter) being divided into Branches or Filaments to be dispersed through all these minute

nute Parts, we must be convinced that the nervous Fibrils are very small. From the Examination of the *minimum visibile*, it is demonstrated, that each Fibre in the *Retina* of the Eye, or expanded optick Nerve, cannot exceed the Size of the 32,400 Part of a Hair.

10. The medullary Substance, of which the nervous Fibrils are composed, is very tender, and would not be able to resist such Forces as the Nerves are exposed to within the Bones, nor even the common Force of the circulating Fluids, were not the *Pia Mater*, and *Tunica Arachnoides* continued upon them; the former giving them Firmness and Strength, and the latter furnishing a cellular Coat to connect the Threads of the Nerves, to let them ly soft and moist, and to support the Vessels which go with them.

It is this cellular Substance that is distended when Air is forced through a Blow-pipe, thrust into a Nerve, and that makes a Nerve appear all spungy, after being distended with Air till it dries; the proper nervous Fibrils shrivelling so in drying, that they scarce can be observed.

11. These Coats (§ 10.) would not make the Nerves strong enough to bear the stretching and Pressure they are exposed to in their Course to the different Parts of the Body; and therefore, where the Nerves go out at the Holes in the *Cranium* and *Spine*, the *Dura Mater* is closely wrapt round them, to collect their disgregated Fibres into tight firm Cords; and that the Tension which they
may

may happen to be exposed to, may not injure them before they have got this additional Coat, it is firmly fixed to the Sides of the Holes in the Bones through which they pass.

12. The nervous Cords thus composed of nervous Fibrils, cellular Coat, *Pia* and *Dura Mater*, have such numerous Blood-vessels, that after their Arteries only are injected, the whole Cord is tinged of the Colour of the injected Liquor; and if the Injection is pushed too violently, the cellular Substance of the Nerves is at last distended with it.

13. A nervous Cord, such as has been just now described, (§ 12.), has very little Elasticity, compared with several other Parts of the Body. When cut out of the Body, it does not become observably shorter, while the Blood-vessels contract three eighths of their Length.

14. Nerves are generally lodged in a cellular or fatty Substance, and have their Course in the Interstices of Muscles, and other active Organs, where they are guarded from Pressure; but in several Parts they are so placed, as if it was intended that they should there suffer the vibrating Force of Arteries, or the Pressure of the contracting Fibres of Muscles.

15. The larger Cords of the Nerves divide into Branches as they go off to the different Parts; the Branches being smaller than the Trunk from which they come, and making generally an acute Angle where they separate.

16. In

16. In several Places, different Nerves unite into one Cord, which is commonly larger than any of the Nerves which form it.

17. Several Nerves, particularly those which are distributed to the Bowels, after such Union, (§ 16.), suddenly form a hard Knot considerably larger than all the Nerves of which it is made. These Knots were called *Corpora olivaria*, and are now generally named *Ganglions*.

18. The *Ganglions* have thicker Coats, more numerous and larger Blood-vessels, than the Nerves; so that they appear more red and muscular. On dissecting the *Ganglions*, Fibres are seen running longitudinally in their Axes, and other Fibres are derived from their Sides in an oblique Direction to the longitudinal ones.

19. The Nerves which go out from the *Ganglions* are no way remarkably different from other Nerves.

20. The Nerves sent to the Organs of the Senses, lose there their firm Coats, and terminate in a pulpy Substance. The *optick Nerves* are expanded into the soft tender Webs, the *Retinæ*. The *auditory Nerve* has scarce the Consistence of *Mucus* in the *Vestibulum*, *Cochlea* and *femicircular Canals* of each Ear. The *Papillæ* of the Nose, Tongue and Skin, are very soft.

21. The Nerves of Muscles can likewise be traced till they lose their Coats and become very soft; from which, and what we observed of the sensory Nerves, (§ 20.), there

there is Reason to conclude, that the muscular Nerves are also pulpy at their Terminations, which we cannot indeed prosecute by Dissection.

22. It would seem necessary that the Extremities of the Nerves should continue in this soft flexible State, (§ 20. 21.), in order to perform their Functions right: For, in proportion as Parts become rigid and firm by Age, or any other Cause, they lose of their Sensibility, and the Motions are more difficultly performed.

23. Though the Fibres in a nervous Cord are firmly connected, and frequently different Nerves join into one Trunk, or into the same *Ganglion*; yet the Sensation of each Part of the Body is so very distinct, and we have so much the Power of moving the Muscles separately, that, if the Nerves are principal Agents in these two Functions, which I shall endeavour to prove they are, we have Reason to believe that there is no Union, Confusion, or immediate Communication of the proper nervous Fibrils, but that each Fibre remains distinct from its Origin to its Termination.

24. Changes produced any way upon the Coats of the Nerves, cannot however miss to affect the nervous Fibrils. The cellular Substance may be too full of Liquor, or may not supply enough; the Liquor may not be of a due Consistence, or it may be preternaturally obstructed and collected. The *Pia Mater* may be too tense or too lax, as may also the *Dura Mater*; their Vessels

may be obstructed; their proper Nerves may be violently irritated, or lose their Power of acting; and a great many other such Changes may happen, which will not only occasion Disorders in particular Nerves, but may cause the *Sympathy* so frequently observed among the Nerves; which is so necessary to be attentively regarded in a great many Diseases, in order to discover their true State and Nature, that, without this Knowledge, very dangerous Mistakes in the Practice of Physick and Surgery may be committed.

25. Many Experiments and Observations concur in proving, that when Nerves are compressed, cut, or any other way destroyed, the Parts served by such Nerves, farther from the Head or Spine, than where the injuring Cause has been applied, have their Sensations, Motions, and Nourishment, weakened, or lost, while no such Effects are seen in the Parts nearer to the Origin of those Nerves; and in such Experiments where the Cause impeding the Nerves to exert themselves could be removed, and the Structure of the Nerves not injured; as for Example, when a Ligature made upon a Nerve, and stopping its Influence has been taken away, the Motion and Sensation of the Parts soon were restored. From which it would appear, that the Nerves are *principal* Instruments in our Sensations, Motions, and Nourishment; and that this Influence of the Nerves is not inherent in them, without

out the Communication between these Cords and their Origin is preserved.

It will be no Objection to this Conclusion, that sometimes, upon cutting a Nerve, the Effects above mentioned have been felt for a short Time; but afterwards the Person was sensible of no Numbness or Immobility; for where-ever this is said to have happened, the cut Nerve was only one of several which were sent to the Member; the want of whose Influence was felt no longer, than till the Habit was acquired of performing the Functions easily by the other Nerves.

It is of no great Weight as an Objection, that when a Ligature is drawn very hard upon a Nerve, the Nerve never again recovers its Influence upon the Parts it is distributed to beyond the Ligature, but is of as little Effect as if it had been cut through; which is to say, that its Texture has been altered beyond Recovery. The same thing is to be seen by tying a Thread tight round a tender Twig of any Vegetable; it decays.

26. Experiments and Observations shew too, that when Parts of the *Encephalon* or *Medulla spinalis* have been irritated, compressed, or destroyed, the Parts of the Body, whose Nerves had their Origin from such affected Parts of the *Encephalon*, or *Medulla spinalis*, became convulsed, paralytick, insensible or wasted; and in such Cases where the injuring Cause could be removed from the Origin of the Nerves, the morbid Sym-

ptoms observed in the Parts to which these Nerves were distributed, went off upon the Removal of that Cause. From which it is thought reasonable to conclude, that the Nerves must not only have a Communication with their Origin, but that the Influence they have upon the Parts they are distributed to, depends on the Influence which they derive from the *Medulla Encephali* and *spinalis*.

27. Though the *Medulla spinalis* has its own Vessels and cineritious Substance which assists to form its *Medulla*; yet a very large Share of the medullary Substance within the Spine is derived from the *Encephalon*, whose *Medulla oblongata* descends from the Head, and the Influence of the *Medulla spinalis* on its Nerves depends in a great Measure on this *Medulla oblongata* of the Head. Hence an Injury done to any Part of the *Medulla spinalis*, immediately affects all the Parts whose Nerves have their Origin below where the injuring Cause is applied to the Spinal Marrow. A Luxation of a *Vertebra* in the Loins makes the lower Extremities soon paralytick; a transverse Section of the *Medulla* at the first *Vertebra* of the Neck, soon puts an End to Life.

28. If such Causes produce constantly such Effects (§ 25. 26. 27.) in us, and other Creatures living in nearly the same Circumstances as we do, the Conclusions already made will be good, notwithstanding Examples of Children and other Creatures being
born

born without *Brains* or *Medulla spinalis*; or notwithstanding the Brains of adult Creatures being much changed in their Texture by Diseases, and notwithstanding *Tortoises*, and some other Animals, continued to move a considerable Time after their Heads were off. We may be ignorant of the particular Circumstances requisite or necessary to the Being or Wellbeing of this or that particular Creature; and we may be unable to account for a great many *Phænomena*; but we must believe our Eyes in the Examination of Facts; and if we see constantly such Consequences from such Actions, we cannot but conclude the one to be the Cause, and the other the Effect. It would be as unjust to deny the Conclusions made in the three preceeding Articles, because of the seemingly preternatural *Phænomena* mentioned in the Beginning of this Article, as it would be to deny the Necessity of the Circulation of the Blood in us and Quadrupeds, because a Frog can jump about, or a Tortoise can walk long after all the Bowels of its Thorax and Abdomen are taken out, or because the different Parts of a Worm crawl after it has been cut into a great many Pieces. It is therefore almost universally agreed that the Nerves are *principal* Instruments in our Sensations, Motion and Nourishment; and that the Influence which they have is communicated from their Origin, the *Encephalon* and *Medulla spinalis*. But Authors are far from agreeing about the Manner in which

this Influence is communicated, or in what Way Nerves act to produce these Effects.

29. Some alledge, that *the nervous Fibres are all solid Cords acting by Elasticity or Vibration.* Others affirm, that *those Fibres are small Pipes conveying Liquors, by means of which all their Effects are produced.*

30. The Gentlemen, who think the nervous Fibres solid, raise several Objections to the other Doctrine; which I shall consider afterwards, and endeavour to shew the Fitness of their own Doctrine to account for the Effects commonly observed to be produced by the Nerves.

The Objects of the Senses plainly (say they) make Impulses on the Nerves of the proper Organs, which must shake the nervous Fibrils; and this Vibration must be propagated along the whole Cord to its other Extremity or Origin, as happens in other tense Strings; and these Vibrations being differently modified, according to the Difference of the Object, and its different Application, produce the different Ideas we have of Objects.

31. To this Account of the Sensations, it is objected, 1st, That Nerves are unfit for Vibrations, because their Extremities, where Objects are applied to them, are quite soft and pappy (§ 20.), and not susceptible of the Vibrations supposed; and if there could be any little Tremor made here by the Impulse of Objects, it could not be continued along the nervous Cord, because the cellular Substance by which each particular Fibre

bre is connected to the neighbouring ones (§ 10), and the fatty Substance in which the nervous Cord is immersed (§ 14.), would soon stifle any such vibratory Motion.

The 2^d Objection to this Doctrine is, that, supposing the Nerves capable of Vibrations by the Impressions of Objects, these Vibrations would not answer the Design. For if what we know of other vibrating Strings, to wit, that their Tone remains the same, unless their Texture, Length or Tension is altered, and that different Substances striking them, do no more than make the Sound higher or lower; if these Properties are to be applied to Nerves, then it will follow, that the same Nerve would constantly convey the same Idea, with no other Variety than of its being weaker or stronger, whatever different Objects were applied to it; unless we supposed the Nerve changed in its Texture, Length or Tension, each Time a different Object is applied; which, it is presumed, no body will undertake to prove does happen. But further, if ever such a Variety of Vibrations could be made, our Sensations would notwithstanding be confused and indistinct, because the tremulous nervous Fibre being firmly connected, and contiguous to several other Fibres of the same Cord, would necessarily shake them too, by which we should have the Notion of the Object as applied at all the different Parts where the Extremities of these Fibres terminate.

32. In whatever way the Favourers of the Doctrine of solid Nerves please to apply the Elasticity of Nerves to the Contraction of Muscles; their Adversaries insist that Nerves are too weak to resist such Weights as the Muscles sustain; they would surely break, especially as they are in a great measure, if not wholly, deprived of their strong Coats before they come to the Part of the Muscle they are immediately to act upon (§ 21.); and the Nerves being found to have little or no Elasticity to shorten themselves (§ 12.), shews them altogether unfit for such an Office as this of contracting Muscles in the way proposed of their acting by Elasticity.

33. As a further Objection against either Motion or Sensation being owing to the Elasticity of the Nerves, it is said, that if this Doctrine was true, the Sensations would be more acute, and the Contractions of Muscles would be greater and stronger, when the Parts become firmer and more rigid by Age; for then their Elasticity is increased: Whereas, on the contrary, it appears (§ 22.), that then the Sensations are blunted, and muscular Contraction becomes less and weaker.

34. If the Nerves were granted to be elastick, and to communicate a springy Force to all the Parts they are distributed to; they might appear necessary in this View to assist the Application of the nutritious Particles of the Fluids to the Sides of the Vessels which these Particles were to repair; and so far might well enough account for the Share which

which Nerves are thought to have in Nutrition : Yet if we cannot make use of Elasticity in the other two Functions of Sensation and Motion, we must also endeavour to find out some other Way for the Nerves to act in Nutrition ; which will be done afterwards.

35. Having thus stated the Reasons for and against the Nerves acting as solid Strings, let us likewise relate the Arguments for Nerves being Pipes, and the Objections to this Doctrine.

A great Argument of those who think the Nerves to be Tubes conveying Liquors, is the strong Analogy of the Brain and Nerves to other Glands of the Body and their Excretories, where a manifest Secretion of Liquor is made in the Glands to be conveyed by the Excretories, to the proper Places in which it ought to be deposited : They think that the vascular Texture of the *Cortex* of the *Encephalon* and *Medulla spinalis* (§ 1.), the Continuation of the *Cortex* in forming the medullary Substance (§ 2. 3.), the fibrous Texture (§ 5.) and succulent State of this *Medulla* (§ 4.), and its being wholly employed to form the Nerves (§ 6.), where the fibrous Texture is evident (§ 8.) ; all these Things, say they, conspire to shew such a strong Analogy between these Parts and the other Glands of the Body, as carries a Conviction that there is a Liquor secreted in the *Encephalon* and *Medulla spinalis*, to be sent out by the Nerves to the different Parts of the Body.

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36. The following Objections are raised to this Argument in favour of a Liquor conveyed in the Nerves, from the Analogy of the Glands. 1st, Other Glands, it is said, have their Excretories collected into a few large Pipes, and not continued in such a great Number of separate Pipes, as far as the Places where the Liquors are deposited; which last must be the Case, if the Nerves are the Excretories of the glandular Brain. 2^{dly}, We see the Cavities, and can examine the Liquors in the Excretories of other Glands much smaller than the Brain; which cannot be done in the Nerves. 3^{dly}, If the Nerves were Pipes, they would be so small, that the Attraction of the Liquors to their Sides, would prevent that Celerity in the Motion of the Liquors, which is requisite to Sensations and Motions. 4^{thly}, If the Nerves were Pipes, they would be cylindrical ones, and consequently not subject to Diseases; or at least we could have no Comprehension of the Diseases in them.

37. The Answer to the 1st of these Objections is, That there are other Glands where there is a manifest Secretion, and in which the Disposition of the Excretories is in much the same Way as in the *Encephalon*: The Kidneys, for Example, have a reticulated *Cortex* of Vessels, from which the *Eustachian* or *Bellinian Medulla*, consisting of longitudinal Fibres and a few Blood-vessels in the same Direction proceeds; and this *Medulla* is collected into ten or twelve *Papillæ*, each of which is formed of numerous small separate

rate Pipes, which singly discharge the Urine into the large membranous Tubes; and these united form the *Pelvis*. Upon comparing this Texture of the Kidneys with that of the *Encephalon* (§ 1. 2. 3. 4. 5. 6. 8.), the Analogy will be found very strong.

38. In answer to the 2d Objection, in § 36. it is granted, that Microscopes, Injections, and all the other Arts hitherto employed, have not shewn the Cavities of the nervous Fibrils, or the Liquors contained in them; and from what was said (§ 9.) of the Smallness of the nervous Fibrils, it is not to be expected that ever they should be seen. But so long as such a Number of little Animals can every Hour be brought to the Objectors, in which they can as little demonstrate the Vessels or contained Fluids, it will not be allowed to be conclusive Reasoning, that because ocular Demonstration cannot be given of either Tubes or their Contents, therefore they do not exist. For if we have any Notion of an Animal, it is its being an Hydraulic Machine, which has Liquors moving in it as long as it has Life; if therefore such little Animals have Vessels and Liquors which we cannot see, why may not some of the Vessels and Liquors of the human Body be also invisible to us.

To avoid this Answer to the Objection, it is further urged, That though we might not see the nervous Tubes or the Liquors they contain, as they naturally flow; yet if such Liquors really exist, they ought to discover themselves, either by a Nerve's swelling when
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it is firmly tied; or that, however subtile their Fluids are, they might be collected in some Drops at least, when the cut End of a Nerve of a living Animal is kept some Time in the exhausted Receiver of an Air-pump. It is affirmed, that neither did the tied Nerve swell between the Brain and Ligature, nor was there any Liquor collected in the Receiver of the Air-pump; from which it is concluded, that there is no Liquor in the Nerves.

Some, who say they have tried these Experiments, affirm, that in young Animals the Nerve does swell above the Ligature, and that a Liquor does drill out upon cutting a Nerve.—Whether Swelling or Liquor is seen or is not seen in these Experiments, no Conclusion for or against a nervous Fluid can be made from them; for the Swelling of the Nerve after it is tied, or the Efflux of Liquors from its Extremity, will never prove either to be the Effect of the Fluid in the proper nervous Fibrils, so long as they might be occasioned by the Liquors in the larger Vessels of the cellular Substance of the Nerves; and if these same Vessels of the Coats of the Nerves do not discover their Liquors by these Experiments, it is far less to be expected, that the much more subtile Nerves will discover theirs.

39. The 3^d Objection to the Doctrine of the Brain being a Gland, and the Nerves its Excretories, supposes a more rapid Motion necessary in the Fluid of the Nerves, than what most of the Defenders of the nervous Fluid will now allow; and is afterwards to be

be considered particularly in a more proper Place.

40. The 4th Objection being, that if Nerves are Excretories of a Gland, they must be cylindrical Pipes, in which no Obstructions or Diseases would happen; but since we daily see Diseases in the Nerves, they must therefore not be such Excretories. The Answer is, That Diseases happen often in the Excretories of other Glands, as of the Liver, Kidneys, &c. notwithstanding their cylindrical Form, and their much shorter and less exposed Course. When we consider the very tender Substance of the Brain, the vast Complication of Vessels there, the prodigious Smallness of the Pipes going out from it, the many moving Powers which the Nerves are to undergo the Shock of, and the many Chances which the Vessels, Membranes and cellular Substance accompanying the Nerves have of being disordered, and then affecting the nervous Fibrils, we have very great Reason to be surprised, that these cylindrical Pipes are not much more frequently put out of Order, by too great or too small a Quantity of Liquors; by too viscid or too thin Fluids; by Liquors consisting of too mild and sluggish Particles, or of too acrid pungent ones; by too great or too little Motion given to the Liquors, by the Diameters of the Pipes being too much straitened, or too much enlarged; and by a great many other Varieties of Circumstances which might be supposed, capable of disturbing the Functions of the Nerves, supposing

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them to be cylindrical Excretories of the Gland, the Brain.

41. The numerous Vessels of the *Encephalon* have brought some of the Gentlemen who assert the Nerves to be solid, to acknowledge, that there is a Liquor secreted in the Brain: But then they will not allow that this Liquor is sent out by the proper nervous Fibrils; but that it is poured into the cellular Substance in which the Nerves lie, to keep them moist and supple, and therefore fit for exerting their Elasticity, Vibration, &c. by which, in their Opinion, the Effects commonly ascribed to Nerves are produced.

42. Besides the Objections already mentioned (§ 31. 32.) against the Nerves acting as elastick Strings, this Opinion has some other Difficulties, which may be objected to it: For Instance, there is not one analogous Example, in the whole Body, of Liquors secreted in a large Gland, to be poured into a cellular Substance, as is here supposed; the Liquors in the Cells of the *tunica cellularis* of other Parts are separated from the little Arteries which are distributed to these Cells.

Further, it cannot be imagined, how a Liquor secreted in the *Cortex* of the Brain, should make its Way through the *Medulla*, to come out into the cellular Membranes on the Surface of that *Medulla*.

Lastly, A very simple Experiment, of injecting Water by the Artery of any Member, and thereby filling the cellular Substance
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of the Nerves of that Member, shews evidently, that the Liquor of the *tunica cellularis* of the Nerves has the same Fountain as the Liquor has in the *tunica cellularis* any where else, that is, from the little Arteries dispersed upon it.

43. The Doctrine of a Fluid in the Nerves, is not only thus supported by the Analogy of the Brain and Nerves to the other Glands and their Excretories, but those who maintain this Doctrine mention an Experiment which they think directly proves a Fluid in the Nerves. It is this: After opening the Thorax of a living Dog, catch hold of and press one or both the phrenic Nerves with the Fingers, the *Diaphragm* immediately ceases to contract; cease to compress the Nerves, and the Muscle acts again: A second Time, lay hold of the Nerve or Nerves some way above the *Diaphragm*, its Motion stops. Keep firm the Hold of the Nerve, and, with the Fingers of the other Hand, strip it down, from the Fingers which make the Compression, towards the *Diaphragm*, and it again contracts: A Repetition of this Part of the Experiment three or four Times, is always attended with the same Effects; but it then contracts no more, strip as you will, unless you remove the Pressure, to take hold of the Nerves above the Place first pinched; when the Muscle may again be made to contract, by stripping the Nerve down towards it. This Experiment I have done with the Success here mentioned. Let any one try if he can imagine any other reasonable Ac-

count of these Appearances, than that the Pressure by the Fingers stopped the Course of a Fluid in the Nerve; that so much of this Fluid as remained in the Nerve, betwixt the Fingers and *Diaphragm*, was forced into that Muscle by stripping, and when it was all pressed away, the Fingers above preventing a Supply, the Muscle contracted no more till the Fingers were removed, and a fresh Flow by that Means was received from the spinal Marrow, or from that Part of the Nerve which had yet not been so stripped.

44. Some Gentlemen, convinced of the Reasonableness of the Secretion of a Liquor in the Brain to be sent out by the Nerves, but not comprehending how a Fluid could have such a rapid retrograde Motion as they imagined was necessary for conveying the Impressions of Objects made on the Extremities of Nerves to the *Sensorium*, supposed two Sorts of Nerves; one that conveyed a Liquor for muscular Motion and Nutrition; the other composed of solid Nerves, that were to serve for the Organs of the Senses, to convey the Vibrations communicated from Objects to the *Sensorium*.

45. To this Opinion (§ 44.) the Objections against the sensory Nerves acting by Vibration (§ 31.) may be made; and there is so little Reason to suspect any Difference in the Texture of different Parts of the Brain or Nerves, that, on the contrary, the Structure is every where similar, and Branches of the same Nerve often serve both for Sensation and Motion.

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How little Necessity there is for supposing extremely rapid Motions of the nervous Fluid, is to be examined soon, (§ 57. 58).

46. The Hypothesis of great Celerity in the Motion of the Fluid of the Nerves being necessary, gave also Rise to another Division of the Nerves, into *arterious* or *effluent* and *venous* or *refluent*. It was said, that muscular Motion and Nutrition depended on the arterious Nerves; and that the Sensations depended on an accelerated Motion of the nervous Fluid towards the Brain, by the Impressions which the Objects of the Senses make upon the venous Nerves. By this Supposition the Absurdity of rapid Fluxes and Refluxes in the same Canal was prevented, and an Advantage was thought to be gained by it, of saving too great a Waste of the Fluid of the Nerves, which otherwise the *Encephalon* and *Medulla spinalis* could not supply in sufficient Quantity to answer all the Exigencies of Life.

47. To this Opinion (§ 46.) it has been objected, 1st, That there is no Example in the Body, of a secreted Liquor being returned immediately and unmixed to the Gland by which it was originally separated from the Mass of Blood; which would be the Case were there venous Nerves. 2^{dly}, There is no Occasion for saving the Fluid of the Nerves in the Way proposed; the Organs for secreting that Fluid being large enough to supply all that is necessary of it in the common Functions of Life. 3^{dly}, If the Fluid

of the the Nerves was to be thus kept in a perpetual Circulation, it would soon become too acrid for continuing with Safety in such sensible tender Vessels as the Brain and Nerves are composed of. 4thly, This Hypothesis will not answer the Design for which it was proposed: For though the momentary Application of an Object might cause an Acceleration in the Fluid of venous Nerves, yet if the Object was kept applied to the Nerves, it would stop their Fluid, so that it could not go forward to the Brain; and therefore, according to this Doctrine, we should be sensible of no Objects, except those whose Application to the Organs of the Senses was momentary.

48. Let us now suppose it probable, that the *Encephalon* and *Medulla spinalis* secern a Liquor from the Blood which is sent into all the Nerves, and that by the Means of this Liquor the Nerves perform the Offices commonly assigned to them, it is next necessary to inquire what kind of Liquor this is, and how it moves, in order to determine how well its Nature and Motion are fitted for performing what is expected from it.

49. The Liquor of the Nerves has been fancied by some to be of a very strong acid or alkaline Nature: But since none of our Juices appear to be of this Sort, and since such Liquors irritate and destroy the Parts of the Body which they are applied to, we cannot conceive how the Brain can separate, or the Nerves could bear any thing
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of such an acrid Nature. This Tenderness and Sensibility of these Organs must hinder us absolutely from supposing that the Liquor of the Nerves can be acrid or pungent, or of the Nature of Spirit of Wine, Hartshorn, &c.

50. Some have imagined the Liquor of the Nerves to be capable of vast Explosion like Gunpowder, or of violent sudden Rarefaction like Air, or of strong Ebullition like boiling Water, or the Mixture of Acids with alkaline Liquors. But as the Mass of Blood from which this Fluid is derived, is not possessed of any such Properties, we cannot suppose the Blood to furnish what it has not in itself. Besides, all these Operations are too violent for the Brain or Nerves to bear; and when once they are begun, they are not so quickly controuled or restrained, as Experience teaches us the Nerves can be made to cease from acting.

51. We are not sufficiently acquainted with the Properties of an *Æther* pervading every thing, to apply it justly in the animal Oeconomy; and it is as difficult to conceive, how it should be retained in a long nervous Cord, as it is to have any Idea how it should act. These are Difficulties not to be surmounted.

52. The surest Way of judging what kind of Liquor this of the Nerves must be, is to examine the Liquors of similar Parts of the Body. All the Glands separate Liquor from the Blood much thinner than the compound Mass itself; such is the *Liquor* poured into the
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the Cavity of the *Abdomen*, *Thorax*, *Ventricles of the Brain*, the *Saliva*, *pancreatic Juice*, *Lymph*, &c. Where-ever there is Occasion for secreted Liquors being thick and viscid, in order to answer better the Uses they are intended for, Nature has provided Reservoirs for them to stagnate in, where their thinner Parts may be carried off by the numerous absorbent Veins dispersed on the Sides of those Cavities; or they may exhale where they are exposed to the open Air. The *Mucus of the Nose* becomes viscid by Stagnation; for, when it is immediately secreted, it is thin and watery; as appears from the Application of Sternutatories, &c. The *Cerumen* of the Ears is of a watery Consistence, when just squeezed out. The *Mucus* of the alimentary Canal grows thick in the *Lacunæ*. The *Bile* in the hepatic Duct has little more Consistence than Lymph; that in the Gall-bladder is viscid and strong. The *Urine* is much more watery as it flows from the Kidneys, than when it is excreted from the Bladder. The *Seed* is thin as it comes from the Testicles, and is concocted in the *Vesiculæ seminales*, &c.

53. Hence (§ 52.) we may safely conclude, that a thin Liquor is secreted in the *Cortex Encephali* and *Medulla spinalis*; and seeing that the Thinness of secreted Liquors is generally, as the Divisions of the Vessels into small subtile Branches, and that the Ramifications within the Scull are almost infinitely subtile, the Liquor secreted in the *Encephalon*

lon may be determined to be among the finest or thinnest Fluids.

54. Seeing also that we can observe no large Reservoir, where the Liquor secreted in the *cortical Substance* is deposited, to have its finer Parts taken off, we have Reason to think, that it goes forward into the Nerves in the same Condition in which it is secreted.

55. By fine or subtile animal Liquors, is meant no more than those which are very fluid, and which seem to consist of a large Proportion of watery Particles, and a lesser one of the oily, saline and terrestrious Particles. Some of the Liquors which we can have in sufficient Quantity to make Experiments with, are so fluid, and have so little Viscidity or Cohesion of Parts, that when laid upon a Piece of clean Mirror, they evaporate without leaving a Stain; such is the Liquor issuing out from the Surface of the *Pleura*, the Lymph, and several others.

If then these Liquors, which are subject to our Examination, the secreting Vessels of which are so large that we can see them, have such a small Cohesion of Parts, it might not be unreasonable to say, that the Liquor of the Nerves is as much more fine and fluid than Lymph, as the Vessels separating it are smaller; and therefore that the Fluid of the Nerves is a defecated Water, with a very small Proportion of the other Principles extremely subtilized.

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56. Two Experiments are said to contradict this Opinion, of the Liquor of the Nerves being so fluid and subtile. One is, that upon cutting the *Cauda equina* of a living Animal, a Liquor, as viscid as the White of an Egg, drops out: The other is, that a wounded Nerve yields a *glairy Sanies*. But these don't appear to be the proper Fluid of the Nerves; since it is evident, that what is discharged in both these Cases, comes out of the cellular Substance involving the nervous Fibrils.

57. Considering how many Experiments make it evident, that there is a constant uninterrupted Stream of Liquors flowing through all the Canals of Animals, which convey Liquors, whose Particles are smaller than the Diameter of their Canal, which is always the Case of Nerves in a natural State; it is surprising how it ever could be thought that the Liquid of the Nerves should be obliged to flow from the Brain to each Muscle the Moment we will; or that this Liquor should flow back with the like Swiftneſs from the Extremity of each Nerve, to which an Object of Sensation is applied. The Nerves, as well as the other Excretories of the Glands, are always full of Liquor; the Degree of Distension of the Canals not being always alike even in a sound State. But this happens without Inconvenience, as the Sides of the Canals have a Power to accommodate themselves to the present Quantity, unless it is very much above or below the natural

ral Standard; in both which Cases, Diseases ensue.

58. The Motion of the Fluid in the Nerves is therefore not only constant, but it is also equal, or nearly so: For, though the Blood in the larger Arteries is moved unequally by the unequal Forces, the Contraction of the Ventricle of the Heart, and the weaker Power, the Systole of the Arteries; yet the Difference between these two moving Powers comes to be less and less perceptible, as the Arteries divide into smaller Branches; because of the numerous Resistances which the Liquors meet with, and because the Canals they move in become larger, till in the very small arterious Branches, there is no Difference in the Velocity of the Liquors from the Effect of the Heart or Arteries. The Motion of the Fluids must still be more equal in the Excretories of Glands, and particularly in those where the Vessels have divided into very minute Branches. So that the nervous Fluid moves constantly, equally, and slowly, unless when its Course is altered by the Influence of the Mind, or by the Pressure of some neighbouring active Organ.

59. We have perhaps no Idea of the Manner in which Mind and Body act upon each other; but if we allow that the one is affected by the other, and that the Fluid of the Nerves (whatever name People please to give it) is a principal Instrument which the Mind makes use of to influence the Actions of the Body, or to inform itself of
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the Impressions made on the Body, we must allow, that the Mind can direct this Instrument differently, particularly as to Quantity and Celerity.

60. Let us now suppose the nervous Fluid such as has been argued for, to wit, an extreme fluid saponaceous Water, moving in a constant, equal, flow Stream, from the *Encephalon* and *Medulla spinalis*, in each of the proper nervous Fibres, except when the Motion is changed by some accessory Cause, such as the Mind, Pressure of other Parts, &c.; and let us examine how well such a Supposition will agree with the Phænomena of the three great Functions, Nutrition, Sensation, and muscular Motion, which the Nerves are principal Instruments of.

In general, we may say, that Nerves can carry Fluids to the most minute Part of the Body, to supply what is wasted in any of the Solids; that the Impression made by the Objects of the Senses on the very soft pulpy Extremities of the Nerves of the Organs of the Senses, must make such a Stop in the equal-flowing nervous Fluid, as must instantaneously be perceptible at the Fountain-head from which the Pipes affected arise; that the constant Flow of the Liquor of the Nerves into the Cavities of the *muscular Fibrillæ*, occasions the natural Contraction of Muscles, by the constant *nifus* it makes to increase the transverse, and to shorten the longitudinal Diameter of each Fibre; and that it is only to allow the Mind a Power of determining a greater Quantity
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of this same Fluid with a greater Velocity, into what muscular Fibres it pleases, to account for the voluntary strong Action of Muscles.

61. But since such a superficial Account would not be satisfactory, it will be expected, that the principal Phænomena of these three Functions, should be explained by the Means of such a Fluid as has been supposed; and that the several Objections against this Doctrine should be answered: Let us attempt this; and where we cannot extricate ourselves from Difficulties which may be thrown in, let us boldly acknowledge Ignorance.

62. *α.* If Water, with a very small Proportion of Oils and Salts from the Earth, proves a fit Nourishment for Vegetables, such a Liquor as the Fluid of the Nerves has been described (§ 55.) may not be unfit for repairing the Waste in Animals.

β. The slow continual Motion of this nervous Fluid (§ 57. 58.), to the most minute Parts of the Body (§ 9.), is well enough calculated to supply the Particles that are constantly worn off from the Solids by the Circulation of the Liquors, and necessary Actions of Life.

γ. The greater proportional Size of the *Encephalon* in young Creatures, than in Adults, seems calculated for their greater proportional Growth: For the younger the Animal is, the speedier Growth and larger *Encephalon* it has.

δ. A Palsy and Atrophy of the Members generally accompanying each other, shew, that Nourishment, Sensation, and Motion, depend on the same Cause.

ε. It was said (§ 25.), that the Nerves were *principal* Instruments in Nutrition: It was not affirmed, that they were the *sole* Instruments; and therefore an *Atrophy* may proceed from the Compression or other Lesion of an Artery, without being an Objection to the Doctrine here laid down.

63. *a.* All Objects of Sense, when applied to their proper Organs, act by Impulse; and this Action is capable of being increased by increasing the impelling Force. In tangible Objects, this is clearly evident; the closer they are pressed to a certain Degree, the more distinct Perception ensues. Odorous Particles need the Assistance of Air moved rapidly, to affect our Nose: Sapid Substances that are scarce sufficient to give us any Idea of their Taste by their own Weight, are assisted by the Pressure of the Tongue upon the Palate: The Rays of Light collected, drive light Bodies before them: Sound communicates a Vibration to all Bodies in harmonic Proportion with it.

The Impulse made thus by any of these Objects on the soft Pulpy Nerves (§ 20.), which are full of Liquor, presses their Sides or Extremities, and their Liquor is hindered to flow so freely as it did. The Canals being all full (§ 57.), this Resistance must instantaneously affect the whole Column of Fluids in the Canals that are pressed, and
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their Origins, and have the same Effect, as if the Impulse had been made upon the Origin itself. To illustrate this by a gross Comparison, let any one push Water out of a Syringe, through a long flexible Pipe fixed to the Syringe, and he is sensible of Resistance, or a Push backwards the Moment any one stops the Orifice of the Pipe, or closes the Sides of it with his Fingers. This Impulse made on the Nerves, and thus communicated to their Origin, varies according to the Strength or Weakness, the Quickness or Slowness, the Continuance or speedy Removal, the Uniformity or Irregularity, the Constancy or Alteration, &c. with which Objects are applied to the Nerves.

b. Whenever any Object is regularly applied with due Force to a Nerve, rightly disposed to be impressed by it, and is communicated, as just now explained, to the *Sensorium*, it gives a true and just Idea of the Object to the Mind.

c. The various Kinds of Impulses which the different Classes of Objects make, occasion a Necessity of having the different Organs of the Senses variously modified, so that the several Impulses may be regularly applied to the Nerves in each Organ; or, in other Words, we must have different Organs of the Senses fitted to the different Classes of Objects.

d. As the Objects have one common Property of Impulse, so all the Organs have most of the Properties of the Organ of Touching in common with the *Papillæ* of

the Skin. In the Nose and Tongue, this is evident : In some Operations on the Eyes we can also perceive this ; as we may likewise do in some Cases where Matter is collected in the internal Ear.

e. These Properties common to the different Objects and Organs, occasion frequently uncommon Effects in the Application of an Object to an Organ proper to another Object of Sensation ; for sometimes we have the same Idea, as if the Object had been applied to its own proper Organ : At other times the Object is as it were changed, and we have the Idea as if the Organ had had its own proper Object applied to it. Thus, for Example, Light is the proper Object to be applied to the Eye, to give us any Idea of Colours ; yet when all Light is excluded from the Eyes, an Idea of Light and Colours may be excited in us by Coughing, Sneezing, Rubbing or striking the Eye-ball.—A Cane vibrating, but not so much as to give any Sound perceptible to the Ear, if it is applied to the Teeth, it raises a strong Idea of Sound ; as a little Insect creeping in the *Meatus auditorius* also does.—The Fingers applied to two rough Surfaces, rubbing on each other, are sensible of the Sound they make ; Surgeons of any Practice in the Cure of fractured Bones, can bear Witness to the Truth of this.—The Fingers dipped in acid and several other acrid Liquors, have a Sensation very like to Tasting.—Smelling and Tasting every Body knows are subservient and assisting to each other. From such Examples

Examples we have further Proof of one general Cause of our Sensations, to wit, Impulse from the Objects ; and of such a Similarity and Relation in the Organs, as might give Reason for imagining that any one of them would be capable of producing the Effect of another, if the Impulses of the different Objects could be regularly applied to each.

f. If the Impulse of an Object is applied with due Force, but irregularly, a confused Idea of the Object is raised. Distant Objects are confused to *Myopes*, as very near ones are to *Presbytae*.

g. If the Application of the Impulse is regular, but the Force with which it is applied is too weak, our Perception of the Object is too faint. One may whisper so low, as not to be heard.

h. If the Application of Objects is too violent, and there is any Danger of the tender Organs of our Senses being hurt or destroyed, the uneasy Sensation, we call *Pain*, is raised, whatever the Organ thus injured is. The Objects of feeling affect every Organ : Thus Pressure, cutting, pricking, Salts, pungent Oils, great Heat, violent Cold, &c. occasion Pain, where-ever they are applied. Besides this, every particular Organ can be affected with Pain, by the too violent Application of its own proper Object. Too much Light pains the Eyes ; very loud Sound stuns the Ears ; very odorous Bodies and too sapid Objects hurt the Nose and Tongue. A pretty sure Proof this, that

the Objects of our Senses all act; and that the Organs are all impressed in nearly the same Way.

i. Whenever this uneasy Sensation, *Pain*, is thus raised, a Sort of Necessity is as it were imposed upon the Mind, to endeavour to get free of the injuring Cause, by either withdrawing the grieved Part of the Body from it, as one retires his Hand when his Finger is pricked or burnt; or the injuring Cause is endeavoured to be forced from the Body, as a *Tenesmus* pushes acrid *Fæces* out of the *Rectum*. In both these Operations, a convulsive Contraction is immediately made in the lesed Part, or in the Neighbourhood of it; and if the Irritation is very strong or permanent, the greater Part of the nervous System comes to be affected in that spasmodic or convulsive Way.

This *Nisus* of the Mind to free the Body of what is in danger of being very hurtful, may serve to explain the Phænomena of a great many Diseases, when we are acquainted with the Distribution of the particular Nerves; and from this we can understand the Operation of Medicines that stimulate; and may learn how, by exciting a sharp, but momentary Pain, we may free the Body of another Pain that would be more durable; and that, by having it thus in our Power to determine a Flow of the Liquor of the Nerves to any particular Part, for the Benefit of that Part, or the Relief of any other diseased Part, we can do considerable Service by a right Application of the proper Medicines.

k. If

k. If a Pain-giving Cause is very violent or long continued, it destroys the Organs either irrecoverably, or puts them so much out of Order, that they only gradually recover. People have been made blind or deaf for all their Lives after, by the violent Effect of Light on their Eyes, or of Sound on their Ears; and we are frequently exposed to as much Light and Sound as make us unfit to see or hear for a considerable Time after. I would explain this by a Ligature put round the tender Branch of an Herb. This Ligature drawn to a certain Degree, may weaken the Canals so as to be unfit for the Circulation of the Juices a good While, till they are gradually explicated and made firm by these Juices: A stricter Ligature would disorder the Structure of the Fibres so much, that the Liquors could not recover them. The Analogy is so plain, that it needs no Commentary.

64. 1. In applying the Fluid of the Nerves to the Action of Muscles, it was said, that the natural or involuntary Contraction of Muscles was the *Nisus* which the nervous Fluid flowing constantly into the muscular Fibres makes to distend these Fibrils, by enlarging their transverse Diameters and shortening their Axes; and that voluntary Contraction was owing to a greater Quantity of that nervous Liquor determined towards the Muscle to be put in Action, and poured with a greater *Momentum* into the muscular Fibrils, by the Power of the Mind willing to make such a Muscle to act.

2. It

2. It has been objected to this Account of muscular Motion, that if it was true, the Volume of a Muscle in Contraction necessarily would be considerably increased by so much Liquor poured into its Fibrils; whereas it does not appear, by any Experiment, that the Volume of a Muscle is increased by its being put into Action.

3. To this it has been answered, That the Spaces between the muscular Fibres are sufficient to lodge these Fibres when they swell, during the Contraction of a Muscle, without any Addition to its Bulk; and that it plainly appears that these Spaces between the Fibrils are thus occupied, by the Compression which the larger Vessels of Muscles, which run in those Spaces, suffer during the Action of the Muscle; it is so great, that the Muscle becomes pale by contracting.

4. Another Objection to the Action of Muscles being owing to the Influx of a Fluid into their Fibrils is, That muscular Fibres are distractile, or capable of being stretched; and therefore, when a Fluid is poured into their hollow Fibrils, they would be stretched longitudinally, as well as have their transverse Diameters increased; that is, a Muscle would become longer, as well as thicker, when it is put into Action; whereas it is known to every Body, that a Muscle is shortened while it acts.

5. In answer to this, it has been remarked, That though muscular Fibrils are distractile, yet they will not yield to, or be stretched by every Force, however small, that might be applied

applied to them. A Cord that can be stretched in Length by the Weight of a Pound or two, would not yield in the least to an Ounce or two; and it must likewise be observed, that gradually as any Body is stretched, its Resistance to the stretching Force increases. A Rope may be stretched to a certain Length by a Pound Weight appended to it, which would require two Pounds to stretch it very little further; and therefore the general Observation of Animal Fibres being distractile, cannot be a reasonable Objection to the Account of muscular Motion abovementioned, unless a Proof is brought that the Force which the Liquid of the Nerves must exert upon each Fibre of a Muscle in order to make a Muscle act, is capable of distracting or stretching the Fibres; which has not yet been attempted to be proved.

6. If muscular Motion depends on the Influx of the nervous Liquid, the instantaneous Contraction of a Muscle, when the Mind wills to make it act, will easily be understood, from the Nerves being always full of their Liquor (§ 57.).

7. If either the Nerves of any Muscle do not furnish a sufficient Quantity of their Liquor, or if the Fibres of a Muscle become too easily distractile, such a Muscle will be unactive or paralytick.

8. If too great a Quantity of the Liquor of the Nerves is determined to a Muscle or Muscles, by any Cause which the Mind cannot command, such Muscle or Muscles will be convulsed.

9. If

9. If the Motion of the Liquid of the Nerves is not uniform, but by Disease becomes irregular, an alternate Relaxation and Contraction of Muscles may be the Consequence. Hence trembling Palsies, *chorea sancti Viti*, &c.

10. Though the Nerves may not furnish as much Liquor as may be sufficient to make Muscles contract with Strength enough to overcome the Resistances to their Action, yet there may be enough of Liquor in the Nerves to allow the Impressions of Objects to be conveyed to the *Sensorium*. This may be one Cause of a Member's being sometimes sensible after it cannot be moved.

11. Unless the Liquor of the Nerves acquires some Energy in the Brain, which we have no Reason to think the Circulation of the Fluids in the Vessels can give it, or unless it has other Properties than what we can discover in it, or unless there is an Agent determining its *Momentum* towards some particular Parts which we are not conscious of; if some of these do not obtain, the Action of the Heart continuing of equal Force to propel our Liquors, notwithstanding all the Resistances that are to it, is not to be explained.

12. All Muscles, but especially the Heart, continue to contract in an irregular Way, after they are cut away from the Animal to whom they belonged; which may be owing to the Liquors continuing to
flow

flow in the small Vessels, and being poured irregularly into the muscular *Fibrillæ*.

13. After the Heart, or any other Muscle cut away from an Animal, has ceased to contract, its Contraction may again be restored, by breathing upon it, or pricking it with any sharp Instrument. That Heat or Pricking should, by their *Stimulus* (§ 63. i.), occasion Contraction in a living Creature, may be understood; but how they should have the same Effect in a Muscle separated from an Animal, I know not.

N. B. Num. 11. 12. 13. are as inexplicable upon any other Supposition yet made concerning muscular Motion.

65. I know no Experiment or Observations by which any thing can be proved, or from which any thing can be reasonably inferred concerning the Use of the *Ganglions* of the Nerves; and therefore I do not pretend to give any Account of them.

Of the PARTICULAR NERVES.

'TIS generally said, that there are forty Pair of Nerves in all; of which ten come out from the *Encephalon*, and the other thirty have their Origin from the *Medulla spinalis*.

Of the ten Pair of Nerves which come from the *Encephalon*, the first is the *OLFACTORY*, which long had the Name of the *Mamillary Processes* of the Brain, because in the Brutes, Cows and Sheep, which were
most

most commonly dissected by the Ancients, the anterior Ventricles of the Brain are extended forwards upon these Nerves, and adhere so firmly to them, that the Nerves seem to make the lower Side of the Ventricles. Each of them is large, where it begins to be stretched out; and gradually becoming smaller, as it approaches the cribriform Bone, was imagined to resemble a Nipple. Those who mistook the Ventricles for Part of the Nerves, observing the Cavity in them full of Liquor, concluded, that these olfactory Nerves served to convey the superfluous Moisture of the Brain to the Holes of the Ethmoid Bone through which it passed into the Nose. But in Man, the Ventricles of whose Brain are not thus extended forwards, these Nerves are small, long, and without any Cavity, having their Origin from the *corpora striata*, near the Part where the internal carotid Arteries are about to send off their Branches to the different Parts of the Brain; and in their Course under the anterior Lobes of the Brain, which have each a Depression made for lodging them, the human olfactory Nerves become larger, till they are extended to the cribriform Bone; where they split into a great Number of small Filaments, to pass through the little Holes in that Bone; and then each being joined by a Branch of the fifth Pair of Nerves, is spread on the Membrane of the Nose.

The tender Structure and sudden Expansion of these Nerves on such a large Surface,

face, render it impossible to trace them far; which has made some Authors deny them to be Nerves: But when we break the Circumference of the *cribriform Lamella*, and then gently raise it, we may see the Distribution of the Nerves some Way on the Membrane of the Nose.

The Contrivance of defending these long soft Nerves from being too much pressed by the anterior Lobes of the Brain under which they lie, is singular; because they have not only the prominent orbital Processes of the frontal Bone to support the Brain on each Side, with the Veins going into the longitudinal Sinus, and other Attachments bearing it up, but there is a Groove formed in each Lobe of the Brain itself for them to lodge in. — Their splitting into so many small Branches before they enter the Bones of the Skull, is likewise peculiar to them; for generally the Nerves come from the Brain in disgregated Filaments, and unite into Cords, as they are going out at the Holes of the Bones. This Contrivance is the best for answering the Purpose they are designed for, of being the Organ of Smelling; for had they been expanded upon the Membrane of the Nose into a medullary Web, such as the optic Nerve forms, it would have been too sensible to bear the Impressions of such Objects as are applied to the Nose; and a Distribution in the more common Way, of a Cord sending off Branches, would not have been equal enough for such an Organ of Sensation.

The 2d Pair of Nerves is the *OPTIC*, which rise from the *thalami Nervorum opticorum*, and then, after making a large Curve outwards, run obliquely inwards and forwards, till they unite at the Fore-part of the *Sella Turcica*; and then dividing again, each runs obliquely forwards and outwards to go out at its proper Hole in the sphenoid Bone, accompanied with the ocular Artery, to run afterwards to the Globe of the Eye, within which each is extended into a very fine Cup-like Web, that lines all the Inside of the Eye as far forwards as the *ciliary Circle*, and is universally known by the Name of *Retina*.

Though the Substance of this Pair of Nerves seems to be blended at the Place where they are joined, yet Observations of People whose optic Nerves were not joined at all, and of others who were blind of one Eye from a Fault in the optic Nerve, or in those who had one of their Eyes taken out, make it appear, that there is no such intimate Union of Substance; the optic Nerve of the affected Side only being wasted, while the other was large and plump. And the same Observations are contradictory to the Doctrine of a Decussation of all the Nerves (§ 7.); for the Disease could be traced from the affected Eye to the Origin of the Nerve on the same Side. In many Fishes indeed, the Doctrine of Decussation is favoured; for their optic Nerves plainly cross each other, without any Union at the Part
where

where they are joined in Men and most Quadrupeds.

Those People whose optic Nerves were not joined, having neither seen Objects double, nor turned their Eyes different Ways, is also a plain Proof, that the Conjunction of the optic Nerves will not serve to account for either the uniform Motions of our Eyes, or our seeing Objects single with two Eyes.

The *Retina* of a recent Eye, without any Preparation, appears a very fine Web, with some Blood-vessels coming from its Center to be distributed on it; but, after a good Injection of the Arteries that run in the Substance of this Nerve, as is common to other Nerves, it is with Difficulty that we can observe its nervous medullary Substance.—The Situation of these Vessels in the central Part of the optic Nerve, and the want of medullary Fibres here, where the optic Nerve enters the Ball of the Eye, may be one Reason why we do not see such Bodies, or Parts of Bodies, whose Picture falls on this central Part of the *Retina*.—An Inflammation in those Arteries of the *Retina*, which several Fevers and an *Ophthalmia* are generally attended with, may very well account for the Tenderness in the Eyes, and Inability to bear the Light, which People have in these Diseases.—The Over-distension of these Vessels may likewise serve to account for the black Spots observed on bright-coloured Bodies especially, and for that smoky Fog through which all Objects

are seen by People in some Fevers.—If those Vessels lose their Tone, and remain preternaturally distended, no Objects affect our *Retina*, though the Eye externally appears sound; or this may be one Cause of an *Amaurosis* or *Gutta serena*.—From a partial Distension of these Vessels or *Paralysis* of a Part of the *Retina*, the central Part, or the Circumference, or any other Part of Objects, may be lost to one or both Eyes.

The *THIRD PAIR* rise from the anterior Part of the *Processus annularis*, and piercing the *Dura Mater* a little before, and to a Side of the Ends of the posterior clinoid Process of the sphenoid Bone, run along the *Receptacula*, or *cavernous Sinuses*, at the Side of the *Ephippium*, to get out at the *Foramina lacera*; after which each of them is distributed to the Globe of the Eye, to the *Musculus rectus* of the *Palpebra*, and to the *Attollens*, *Adductor*, *Deprimens*, and *obliquus minor* Muscles of the Eye-ball. These Muscles being principal Instruments in the Motions of the Eye-lid and Eye-ball, this Nerve has therefore got the Name of the *Motor oculi*.——I have frequently observed in Convulsions the Eye-lids widely opened, the *Cornea* turned upward and outwards, and the Eye-balls sunk in the Orbit; which well described the conjunct Action of the Muscles which this Pair of Nerves serves.—The Distension of a considerable Branch of the Carotid, which passes over this Nerve near its Origin on each Side, may possibly be the Reason of that Heaviness in the Eye-lids

kids and Eyes, after drinking hard, or eating much.

The *FOURTH PAIR*, which are the smallest Nerves of any, derive their Origin from the Back-part of the Base of the *Testes*; and then making a long Course on the Side of the annular Protuberance, enter the *Dura Mater* a little farther back, and more externally than the third Pair, to run also along the *Receptacula*, to pass out at the *Foramina lacera*, and to be entirely spent on the *Musculi trochleares*, or superior oblique Muscles of the Eyes. The rotatory Motions, and the Advancement of the Eye-balls forward, by which Motion several of our Passions are expressed, principally depending on these Muscles, the Nerves that serve them have got the Name of *PATHE-TICI*. — Why these small Nerves should be brought so far to this Muscle, when it could have been supplied easily by the *Motor oculi*, I know not.

The *FIFTH PAIR* are large Nerves, rising from the annular Process, where the medullary Processes of the *Cerebellum* join in the Formation of that *Tuber*, to enter the *Dura Mater* near the Point of the petrous Process of the Temporal Bones; and then sinking into the *Receptacula* at the Side of the *Sella Turcica*, each becomes in Appearance thicker, and goes out of the Scull in three great Branches.

The first Branch of the fifth is the *O-PHTHALMIC*, which runs through the *Foramen lacerum* to the Orbit, having in its

Passage thither a Connexion with the sixth Pair. It is afterwards distributed to the Ball of the Eye with the third ; to the Nose, along with the Olfactory, which the Branch of the fifth that passes through the *Foramen orbitarium internum* joins, as was already mentioned in the Description of the first Pair. This ophthalmic Branch likewise supplies the *Glandula lacrymalis*, Fat, Membranes, Muscles, and the Teguments of the Eye-lids ; its longest farthest extended Branch passing through the *Foramen superciliare* of the *Os frontis*, to be distributed to the Forehead.

The small Fibres which this first Branch of the fifth and the third Pair of Nerves send to the Eye-ball, being situated on the optic Nerve, and after piercing the sclerotick Coat running on the choroid Coat on the Outside of the *Retina* in their Course to the *Uvea* or *Iris*, may be a Cause of the Sympathy between the optic Nerve and the *Uvea* ; by which we more readily acquire the Habit of contracting the *Iris*, and thereby lessen the Pupil, when too strong Light is excluded, and, on the contrary, enlarge the Pupil, when the Light is too faint.—This, with the Sympathy which must arise from some of the Nerves of the Membrane of the Nostrils, being derived from this first Branch of the fifth Pair of Nerves, may also be the Cause, why an Irritation of too strong Light falling upon the *Retina*, may produce Sneezing, as if a *Stimulus* had been applied to the Membrane of the Nose itself ; or why Irritation of the
Nose

Nose causes the Eye-lids to shut convulsively, and makes the Tears to flow plentifully; and why Medicines put into the Nose, do often great Service in Diseases of the Eyes.

—In the Megrim all the Branches of this Nerve discover themselves to be affected; for the Forehead is racked with Pain, the Eye-ball is pained, and feels as if it was squeezed, the Eye-lids shut convulsively, the tears trickle down, and an uneasy Heat is felt in the Nose. Hence we can understand, where external Medicines will have the best Effect, when applied to remove this Disease, to wit, to the Membrane of the Nose, and to the Forehead; and why alternate Pressure near the superciliary Hole of the frontal Bone, or Sneezing, sometimes gives immediate Relief in the Megrim.

The second Branch of the fifth Pair of Nerves may be called *MAXILLARIS SUPERIOR*, from its serving principally the Parts of the Upper Jaw. It goes out at the round Hole of the sphenoid Bone, and sends immediately one Branch in the Channel on the Top of the *Antrum maxillare*; the Membrane of which and the upper Teeth are supplied by it in its Passage. As this Branch is about to go out at the *Foramen orbitarium externum*, it sends a Nerve through the Substance of the *Os maxillare* to come out at Steno's Duct, to be distributed to the Fore-part of the Palate; and what remains of it escaping at the *external orbitar* Hole, divides into a great many Branches, that supply the Cheek, upper Lip, and Nostril. The

next

next considerable Branch of the *superior maxillary* Nerve, is sent into the Nose by the Hole common to the Palate and sphenoidal Bone; and the remaining Part of this Nerve runs in the *Palato-maxillaris* Canal, giving off Branches to the Temples and pterygoid Muscles, and comes at last into the Palate to be lost.—Hence the Ach in the Teeth of the Upper Jaw occasions a gnawing Pain deep-seated in the Bones of the Face, with Swelling in the Eye-lids, Cheek, Nose, and upper Lip; and, on the other hand, an Inflammation in these Parts, or a Megrim, is often attended with sharp Pain in the Teeth.—Hence an Obstruction in the Duct of the maxillary Sinus, which obliges the Liquor secreted there to find out a preternatural Route for itself, may be occasioned by the Pain of the Teeth.

The third or *MAXILLARIS INFERIOR* Branch of the fifth Pair going out at the oval Hole of the sphenoid Bone, serves the Muscles of the Lower Jaw, and the Muscles situated between the *Os hyoides* and *Jaw*: All the salivary Glands, the *Amygdalæ*, and the external Ear, have Branches from it: It has a large Branch lost in the Tongue, and sends another through the Canal in the Substance of the Lower Jaw, to serve all the Teeth there, and to come out at the Hole in the Fore-part of the Jaw, to be lost in the Chin and under Lip.—Hence a convulsive Contraction of the Muscles of the Lower Jaw, or the Mouth's being involuntarily shut, a great Flow of Spittle or Salivation, a Pain in the
Ear

Ear, especially in Deglutition, and a Swelling all about the Throat, are natural Consequences of a violent Irritation of the Nerves of the lower Teeth in the Tooth-ach; and Pain in the Teeth and Ear, is as natural a Consequence of an *Angina*.—Hence alternate Pressure on the Chin may sometimes relieve the Violence of a Tooth-ach.—Hence destroying the Nerves of a Tooth by actual or potential Cauteries, or pulling a carious Tooth, so often removes immediately all these Symptoms.—Hence no Cure is to be found for some Ulcers in the Upper or Lower Jaw, but by drawing a Tooth.—Perhaps the Sympathy of the Organs of Tasting and Smelling, may in some measure depend on their both receiving Nerves from the fifth Pair.

The *SIXTH PAIR*, which is the smallest except the fourth, rises from the Forepart of the *Corpora pyramidalia*; and each entering the *Dura Mater*, some way behind the posterior clinoid Process of the sphenoid Bone, has a long Course below that Membrane, and within the *Receptaculum* at the Side of the *Sella Turcica*, to go out at the *Foramen lacerum* into the Orbit, to serve the abductor Muscle of the Eye. A Defect in this Nerve may therefore be one Cause of a *Strabismus*. In the Passage of this Nerve below the *Dura Mater*, it lies very contiguous to the internal carotid Artery, and to the ophthalmick Branch of the fifth Part of Nerves. At the Place where this sixth Pair is contiguous to the Carotid, a Nerve, either goes from

from each of them in an uncommon Way, to wit, with the Angle beyond where it rises obtuse, to descend with the Artery, and to form the Beginning of the intercostal Nerve, according to the common Description; or, according to other Authors, this Nerve comes up from the great *Ganglion* of the *Intercostal*, to be joined to the sixth here.

The Arguments for this latter Opinion are, That, according to the common Opinion, this Beginning of the *intercostal* Nerve, as 'tis called, would rise in a Manner not so ordinary in Nerves. In the next place, it is observed, that the sixth Pair is larger nearer to the Orbit, than it is before it comes to the Place where this Nerve is said to go off; and therefore it is more probable, that it receives an Addition there, rather than gives off a Branch. *Lastly*, It is found, that upon cutting the *intercostal* Nerves of living Animals, the Eyes plainly were affected; they lost their bright Water; the Gum, or Gore, as we call it, was separated in greater Quantity; the Pupil was more contracted; the cartilaginous Membrane, at the internal Canthus, came more over the Eye; and the Eye-ball itself was diminished.

To this it is answered, in Defence of the more common Doctrine, 1st, That other Branches of Nerves go off in a reflected Way, as well as this does, supposing it to be the Beginning of the *Intercostal*; and that the Reflexion would rather be greater, if it is thought to come up from the *Intercostal* to the sixth. 2^{dly}, It is denied that this Nerve
is

is for ordinary thicker at its Fore than its Back part; and if it was supposed to be thickest nearest to the Orbit, the Conclusion made above could not be drawn from this Appearance, because other Nerves enlarge sometimes where there is no Addition made to them, as in the Instance already mentioned of the Trunk of the fifth Pair while below the *Dura Mater*. 3dly, The Experiments on living Animals shew indeed, that the Eyes are affected upon cutting the intercostal Nerve, but not in the Way which might have been expected, if the *Intercostal* had furnished such a Share of the Nerve that goes to the *Abductor* Muscle of the Eye; for it might have been thought, that this Muscle would have been so much weakened immediately upon cutting the *Intercostal*, as its Antagonist the *Adductor* would have greatly prevailed over it, and have turned the Eye strongly in towards the Nose; which is not said to be a Consequence of this Experiment. So that the Arguments are still equivocal; and more Observations and Experiments must be made, before it can be determined with Certainty, whether the sixth Pair gives or receives a Branch here. In the mean time, I shall continue to speak about the Origin of the *Intercostal* with the Generality of Anatomists.

At this Place where the *Intercostal* begins, the fifth Pair is contiguous and adherent to the sixth; and it is generally said, that the ophthalmic Branch of the fifth gives a Branch or two to the Beginning of the *Intercostal*,

tercostal, or receives such from it. Others deny any such Communication between them, and those who affirm the Communication, confess, that in some Subjects they could not see it. After examining the Nerves here in a great many Subjects, I cannot determine whether or not there are nervous Filaments going from the one to the other. Sometimes I have thought that I traced them evidently; at other times I observed that what I dissected for nervous Filaments, was collapsed cellular Substance; and in all the Subjects where I had pushed an Injection successfully into the very small Arteries, I could only observe a *Plexus* of Vessels connecting the one to the other. In any of these Ways, however, there is as much Connexion, as we are assured, from many Experiments and Observations on other Nerves, is sufficient to make a very great Sympathy among the Nerves here.—Possibly the Appearances in the Eyes of Dogs, whose intercostal Nerves were cut, might be owing to this Sympathy.

The *SEVENTH PAIR* comes out from the lateral Part of the *annular Process*, behind where the medullary Processes of the *Cerebellum* are joined to that *Tuber*; and each being accompanied with a larger Artery than most other Nerves, enters the *internal Meatus auditorius*, where the two large Bundles of Fibres, of which it appeared to consist within the Scull, soon separate from each other; one of them entering by several small Holes into the *Vestible*, *Cochlea*, and *semicircular*

femicircular Canals, is stretched on this inner *Camera* of the Ear in a very soft pulpy Substance; and being never seen in the Form of a firm Cord, such as the other Parcel of this and most other Nerves become, is called *PORTIO MOLLIS* of the auditory Nerve.

The other Part of this seventh Pair passes through *Galen's Foramen cæcum*, or *Fallopius's Aquæduct*, in its crooked Passage by the Side of the *Tympanum*; in which Passage, a Nerve sent from the lingual Branch of the inferior maxillary Nerve, along the Outside of the *Tuba Eustachiana*, and cross the Cavity of the *Tympanum*, where it has the Name of *Chorda Tympani*, is commonly said to be joined to it. The very acute Angle which this Nerve makes with the fifth, or the sudden violent Reflexion it would suffer on the Supposition of its coming from the fifth to the seventh, appears unusual; whereas, if we suppose that it comes from the seventh to the fifth, its Course would be more in the ordinary Way, and the *Chorda Tympani* would be esteemed a Branch of the seventh Pair going to join the fifth. This smaller Bundle of the seventh gives Branches to the Muscles of the *Malleus*, and to the *Dura Mater*, while it passes through the bony crooked Canal, and at last comes out in a firm Cord named *PORTIO DURA*, at the End of this Canal, between the *styloid* and *mastoid* Processes of the temporal Bone, giving immediately Filaments to the little oblique Muscles of the Head, and to those

that rise from the styloid Process. It then pierces through the parotid Gland, and divides into a great many Branches, which are dispersed in the Muscles and Teguments that cover all the Side of the upper Part of the Neck, the whole Face and *Cranium*, as far back as the Temples, including a considerable Part of the external Ear. Its Branches having thus a considerable Connexion with all the three Branches of the fifth Pair, and with the second Cervical, occasion a considerable Sympathy of these Nerves with it. — Hence, in the Tooth-ach, the Pain is sometimes very little in the affected Tooth, compared to what it is all along the Side of the Head and in the Ear. — Hence probably the Relief of the Tooth-ach from Blisters applied behind the Ear, or a hot Iron touching the *Antihelix* of the Ear. — By this Communication or Connexion possibly too it is, that a vibrating String, held between one's Teeth, gives a strong Idea of Sound to the Person who holds it, which no body else can perceive. — Perhaps too the Distribution of this Nerve occasions the Head to be so quickly turned upon the Impression of Sound on our Ears.

The *EIGHTH PAIR* of Nerves rise from the lateral Bases of the *Corpora olivaria* in disgregated Fibres; and as they are entering the anterior internal Part of the Holes common to the *Os occipitis* and *Temporum*, each is joined by a Nerve which ascends within the *Dura Mater* from the tenth of the Head, the first and second cervical, and

and sometimes from inferior Nerves: This every Body knows has the Name of the *NERVUS ACCESSORIUS*. When the two get out of the Scull, the *Accessorius* separates from the eighth, and, descending obliquely outwards, passes through the *Sternomastoideus* Muscle, to which it gives Branches, and afterwards terminates in the *Trapezius* and *Rhomboid* Muscles of the *Scapula*. In this Course it is generally more or less joined by the second cervical Nerve.—Why this Nerve, and several others which are distributed to Muscles, are made to pierce through Muscles, which they might have only passed near to, I do not know.

The large *eighth Pair*, soon after its Exit, gives Nerves to the Tongue, *Larynx*, *Pharynx*, and *Ganglion* of the *Intercostal* Nerve, and being disjoined from the ninth and *Intercostal*, to which it adheres closely some way, runs streight down the Neck behind the internal jugular Vein, and at the external Side of the carotid Artery. As it is about to enter the *Thorax*, a large Nerve goes off from the eighth of each Side: This Branch of the Right-side turns round from the fore to the back Part of the subclavian Artery, while the Branch of the Left-side turns round the great Curve of the *Aorta*, and both of them mounting up again at the Side of the *Oesophagus*, to which they give Branches, are lost at last in the *Larynx*. These are called the *RECURRENT* Nerves, which we are desired to shun in the Operation of *Bronchotomy*, though their deep

Situation protects them sufficiently.—The Muscles of the *Larynx* being in a good Measure supplied with Nerves from the Recurrents, it is to be expected, that the cutting of them will greatly weaken the Voice, though it will not be entirely lost, so long as the superior Branches of the eighth Pair are entire. — Why the recurrent Nerves rise so low from the eighth Pair to go round a large Artery, and to have such a long Course upwards, I know not.

The eighth Pair at or near the Place where the recurrent Nerves go off from it, or frequently the Recurrents themselves send off Nerves to the *Pericardium*, and to join with the Branches of the Intercoastal that are distributed to the Heart.

After these Branches are sent off, the *Parvum* on each Side descends behind the great Branch of the *Trachea*, and gives numerous Filaments to the Lungs in going to the *Oesophagus*. The one of the Left-side running on the Fore-part of the *Oesophagus*, communicates by several Branches with the right one in its Descent to be distributed to the Stomach: The right one gets behind the *Oesophagus*, where it splits and rejoins several times before it arrives at the Stomach, to which it sends Nerves; and then being joined by one or more Branches from the Left-trunk, they run towards the cæliac Artery, there to join into the great *semilunar Ganglion* formed by the two Intercoastals.

From

From the Distribution of this *Par vagum*, we may learn how tickling the *Fauces* with a Feather, or any such Substance, excites a Nausea and Inclination to vomit; — why coughing occasions vomiting, or vomiting raises a Cough. — Hence we see how the nervous *Asthma* and the *Tussis convulsiva*, Kinkcough, are attended with a straitening of the *Glottis*; why Food difficult to digest, occasions the *Asthma* to weakly People; and why *Emetics* have frequently cured the *Asthma* very speedily; — why an Attempt to vomit is sometimes in danger of suffocating *Asthmatic* People; — why the superior Orifice of the Stomach is so sensible, as to be looked on as the Seat of the Soul by some; — why People subject to Distensions of the Stomach, have so often the Sensations of Balls in their Breasts and Throats; — why the *Globus hystericus* is so often attended with a violent Strangulation at the *Glottis*.

The *NINTH PAIR* of Nerves comes from the inferior Part of the *Corpora pyramidalia*, to go out of the Scull at their proper Holes of the occipital Bones. After their Egress they adhere for some way firmly to the eighth and Intercoastal; and then sending a Branch that in many Subjects is joined with Branches of the first and second cervical Nerves, to be distributed to the thyroid Gland and Muscles on the Fore-part of the *Trachea Arteria*, the ninth is lost in the Muscles and Substance of the Tongue. Some have thought this Nerve, and others

have esteemed the third Branch of the fifth Pair of Nerves to be the proper gustatory Nerve. I know no Observations or Experiments to prove either Opinion, or to assure us, that both Nerves do not serve for Tasting, and for the Motion of the Tongue.

The *TENTH PAIR* rises from the Sides of the *Medulla spinalis*, to go out between the *Os occipitis* and *first Vertebra* of the Neck. After each of them has given a Branch to the great Ganglion of the Intercostal Nerve, it is distributed to the oblique Muscles, and to some of the Extensors of the Head. Whether the Name of the tenth of the Head, or of the first Verbral, ought to be given to this Pair of Nerves, is of no such Consequence as to deserve a Debate.

In the Description of the sixth Pair, I followed the usual Way of speaking among Anatomists, and called *that* the Beginning of the Intercostal Nerve which comes out of the Skull; and therefore shall here subjoin a cursory Description of this Nerve, notwithstanding its much larger Part is composed of Nerves coming out from the *Medulla spinalis*. There is no greater Incongruity in point of Method to say, that the Nerve we are describing receives Additions from others that have not been described, than it is to repeat in the Description of a great many Nerves, that each of them gives Branches to form a Nerve which we are ignorant of; which is all the Difference between

tween describing the Intercoſtal before or after the ſpinal Nerves.

The Branch reflected from the ſixth Pair, joined poſſibly by ſome Filaments of the *Ophthalmic* Branch of the fifth, runs along with the internal Carotid Artery, through the crooked Canal formed for it in the *temporal Bone*, where the little Nerve is very ſoft and pappy, and in ſeveral Subjects divides and unites again before it comes out of the Scull. May the Compreſſion of this Nerve by the Carotid when ſtretched during the *Syſtole*, contribute to the *Diſtole* of the Heart? As ſoon as the Nerve eſcapes out of this bony Canal, it is connected a little way with the eighth and ninth; then ſeparating from theſe, after ſeeming to receive additional Nerves from them, it forms a large *Ganglion*, into which Branches from the tenth of the Head, and from the firſt and ſecond Cervical, enter. From this Ganglion the Nerves come out again ſmall to run down the Neck along with the carotid Artery, communicating by Branches with the cervical Nerves, and giving Nerves to the Muſcles that bend the Head and Neck. As the *Intercoſtal* is about to enter the *Thorax*, it forms another Ganglion from which Nerves are ſent to the *Trachea* and to the Heart; theſe deſigned for the Heart joining with the Branches of the eighth, and paſſing between the two great Arteries and the Auricles to the Subſtance of that Muſcle. The *Intercoſtal* after this conſiſting of two Branches, one going

ing behind, and the other running over the Fore-part of the Subclavian Artery, forms a new Ganglion where the two Branches unite below that Artery, and then descending along the Sides of the *Vertebræ* of the *Thorax*, receives Branches from each of the dorsal Nerves; which Branches appearing to come out between the Ribs, have given the Name of Intercostal to the whole Nerve. Where the Addition is made to it from the fifth dorsal Nerve, a Branch goes off obliquely forwards; which being joined by other such Branches from the sixth, seventh, eighth, and ninth Dorsal, an anterior Trunk is formed, that passes between the Fibres of the *Appendix musculosa* of the Diaphragm, to form, along with the other Intercostal and the Branches of the eighth Pair, a large semilunar Ganglion situated between the cæliac and superior mesenteric Arteries; the Roots of which are, as it were, involved in a sort of nervous Net-work of this Ganglion, from which a great Number of very small nervous Threads run out to be extended on the Surface of all the Branches of these two Arteries, so as to be easily seen when any of the Arteries are stretched, but not to be raised from them by Dissection; and thus the *Liver*, *Gall-Bladder*, *Duodenum*, *Pancreas*, *Spleen*, *Jejunum*, *Ilium*, and a large Share of the *Colon*, have their Nerves sent from this great *solar Ganglion* or *Plexus*. — May the peristaltic Motion of the Intestines depend in some measure

measure on the Passage of the Intercoastal Nerves through the Diaphragm?

Several Fibres of this Ganglion, running down upon the Aorta, meet with other Nerves sent from the posterior Trunk of the Intercoastal, which continues its Course along the Sides of the *Vertebræ*, they supply the *Glandulæ renales*, Kidneys and *Testes* in Men, or *Ovaria* in Women; and then they form a Net-work upon the inferior mesenteric Artery where the Nerves of the two Sides meet, and accompany the Branches of this Artery to the Part of the *Colon* that lies in the left Side of the Belly, and to the *Rectum*, as far down as to the lower Part of the *Pelvis*.

The Intercoastal continuing down by the Side of the *Vertebræ* of the Loins, is joined by Nerves coming from between these *Vertebræ*, and sends Nerves to the Organs of Generation and others in the *Pelvis*, being even joined with those that are sent to the inferior Extremities.

The almost universal Connexion and Communication which this Nerve has with the other Nerves of the Body, may lead us to understand the following, and a great many more *Phænomena*: Why the too great Quantity of Bile in the *Cholera* occasions Vomiting as well as Purging. — Why People vomit in Colicks, in Inflammations, or other Irritations of the Liver, or of the Ducts going from it, and the Gall-bladder. — Why a Stone in the Kidneys, or Ureters, or any other Cause irritating those
Organs,

Organs, should so much more frequently bring on Vomiting and other Disorders of the Stomach, than the Stone, or any other stimulating Cause in the Bladder does.—

Why Vomiting is a Symptom of Danger after Child-birth, Lithotomy, and other Operations on the Parts in the *Pelvis*.—

Why the Obstructions of the *Menses* are capable of occasioning Strangulations, Belching, Colicks, Stomach-aches, and even Convulsions in the Extremities.—Why Vesicatories applied from the Ears to the Clavicles of Children labouring under the *Tussis convulsiva*, are frequently of great Service.—Why Worms in the Stomach or Guts excite an Itching in the Nose, or Grinding of the Teeth.—Why Irritations in the Bowels of the Belly occasion sometimes universal Convulsions of the Body.

The *spinal* Nerves rise generally by a Number of disgregated Fibres from both the Fore and Back part of the *Medulla spinalis*, and soon after form a little Knot or Ganglion, where they acquire strong Coats, and are extended into firm Cords. They are distinguished by Numbers, according to the *Vertebræ* from between which they come out; the superior of the two Bones forming the Hole through which they pass, being the one from which the Number is applied to each Nerve. There are generally said to be *thirty Pair* of them; seven of which come out between the *Vertebræ* of the *Neck*, twelve between those of the *Back*,
five

five between those of the Loins, and six from the *false Vertebrae*.

The *FIRST CERVICAL* Pair of Nerves comes out between the first and second *Vertebrae* of the Neck; and having given Branches to join with the tenth Pair of the Head, the second Cervical and Intercostal, and to serve the Muscles that bend the Neck, it sends its largest Branches backwards to the Extensor Muscles of the Head and Neck; some of which piercing through these Muscles, run up on the *Occiput* to be lost in the Teguments there; and many Fibres of it advance so far forward, as to be connected with the *Fibrillae* of the first Branch of the fifth Pair of the Head, and of the *Portio Dura* of the *Auditory Nerve*.—Hence possibly it is that a *Clavus hystericus* changes suddenly sometimes from the Fore-head to a violent Pain and Spasm in the Back-part of the Head and Neck.

The *SECOND CERVICAL* is soon joined by some Branches to the ninth of the Head and Intercostal, and to the first and third of the Neck; then has a large Branch that comes out at the exterior Edge of the *Sternomastoideus* Muscle, where it joins with the *Accessorius* of the eighth Pair; and is afterwards distributed to the *Platysma Myoides*, Teguments of the Side of the Neck and Head, parotid Gland and external Ear, being connected to the *Portio Dura* of the Auditory Nerve, and to the first Cervical. The Remainder of this second cervical is spent on the *Levator Scapulæ*, and the Extensors
of

of the Neck and Head. Generally a large Branch is here sent off to join the *Accessorius* of the eighth Pair, near the superior Angle of the *Scapula*.

To the Irritation of the Branches of this Nerve it probably is, that, in an Inflammation of the parotid Gland, the Neck is pained as far down as the Clavicle, the Head is drawn towards the Shoulder of the affected Side, and the Chin is turned to the other Side. — In opening the external jugular Vein, no Operator can promise not to touch some of the cutaneous Branches of this Nerve with the Lancet; which occasions a sharp pricking Pain in the mean time, and a Numbness of the Skin near the Orifice for some Time after.

The *THIRD PAIR* of the Neck passes out between the third and fourth cervical *Vertebræ*; having immediately a Communication with the second, and sending down a Branch, which, being joined by a Branch from the fourth cervical, forms the *PHRENIC* Nerve. This descending, enters the *Thorax* between the Subclavian Vein and Artery; and then being received into a Groove formed for it in the *Pericardium*, it has its Course along this *Capsula* of the Heart, till it is lost in the middle Part of the Diaphragm. The right Phrenic has a streight Course; but the left one is obliged to make a considerable Turn outwards to go over the prominent Part of the *Pericardium*, where the Point of the Heart is lodged. Hence in violent Palpitations of the Heart,

a pungent acute Pain is felt near the left Orifice of the Stomach.—The middle of the Diaphragm scarce could have been supplied by any other Nerve which could have had such a streight Course as the *Phrenic* has. If the Subclavian Artery and Vein have any Effect upon this Nerve, I do not know it.

The other Branches of the third cervical Nerve are distributed to the Muscles and Teguments at the lower Part of the Neck and Top of the Shoulder. No Wonder then that an Inflammation of the Liver or Spleen, an Abscess in the Lungs adhering to the Diaphragm, or any other Cause capable of irritating the Diaphragm, should be attended with a sharp Pain on the Top of the Shoulder, as well as Wounds, Ulcers, &c. of this Muscle itself. If the Irritation of this Muscle is very violent, it may occasion that convulsive Contraction of the Diaphragm, which is called an *Hiccough*; and therefore an Hiccough in an Inflammation of the Liver has been justly declared to be an ill Symptom.

An Irritation of the thoracic Nerves which produces Sneezing, may sometimes free the phrenic Nerves from any Spasm they occasion; so that Sneezing sometimes takes away the Hiccough; and a Derivation of the Fluid of the Nerves any other Way may do the same Thing: Or the Hiccough may also be sometimes cured, by drawing up into the Nose the Smoak of burning Paper, or other acrid Fumes, and by a Surprise,

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or any other strong Application of the Mind in Thinking, or in distinguishing Objects.

The *FOURTH CERVICAL* Nerve, after sending off that Branch which joins with the third to form the Phrenic, and bestowing Twigs on the Muscles and Glands of the Neck, runs to the Arm-pit, where it meets with the *FIFTH*, *SIXTH*, and *SEVENTH* Cervicals, and *FIRST DORSAL*, that escape in the Interstices of the *Musculi scale-ni*, to come at the Arm-pit, where they join, separate, and re-join, in a Way scarce to be rightly expressed in Words; and after giving several considerable Nerves to the Muscles and Teguments which cover the *Thorax*, they divide into several Branches, to be distributed to all the Parts of the superior Extremity. Seven of these Branches I shall describe under particular Names.

1. *SCAPULARIS* runs streight to the *Cavitas semilunata* of the upper *Costa* of the *Scapula*, which is an Hole in the recent Subject; a Ligament being extended from one Angle of the Bone to the other, giving Nerves in its Way to the Muscles of the *Scapula*. When it has passed this Hole, it supplies the *Supra-spinatus* Muscle; and then descending at the anterior Root of the *Spine* of the *Scapula*, it is lost in the other Muscles that lie on the *Dorsum* of the *Scapula*.

2. *ARTICULARIS* sinks downwards at the *Axilla*, to get below the Neck of the Head of the *Os humeri*, and to mount again at the Back-part of it; so that it almost surrounds the Articulation, and is distributed to the

the Muscles that draw the Arm back, and to those that raise it up.

3. *CUTANEUS* runs down the Fore-part of the Arm near the Skin, to which it gives off Branches; and then divides on the Inside of the Fore-arm into several Nerves, which supply the Teguments there, and on the Palm of the Hand. In opening the Basilic Vein of the Arm, at the ordinary Place, the same Symptoms are sometimes produced, as in opening the external jugular Vein, and from a like Cause, to wit, from hurting a Branch of this cutaneous Nerve with the Lancet.

4. *MUSCULO-CUTANEUS*, or *perforans Casserii*, passes through the *Coracobrachialis* Muscle; and, after supplying the *Biceps flexor cubiti* and *Brachæus internus*, passes behind the Tendon of the Biceps, and over the cephalic Vein, to be bestowed on the Teguments on the Outside of the Fore-arm and Back of the Hand.—This Nerve is sometimes hurt in opening the cephalic Vein, and causes Pain and Numbness for a short Time.

5. *MUSCULARIS* has a spiral course from the *Axilla*, under the *Os humeri*, and backward to the external Part of that Bone, supplying by the Way the extensor Muscles of the Fore-arm, to which it runs between the two *brachiæi* Muscles, and within the *Supinator Radii longus*.—At the Upper-part of the Fore-arm, it sends off a Branch, which accompanies the *Supinator longus* till it comes near the Wrist, where it passes obliquely o-

ver the *Radius*, to be lost in the Back of the Hand and Fingers. — The principal Part of this Nerve pierces through the *supinator Radii brevis*, to serve the Muscles that extend the Hand and Fingers.

6. *ULNARIS* is extended along the Inside of the Arm, to give Nerves to the Muscles that extend the Fore-arm and to the Teguments of the Elbow: Towards the lower Part of the Arm, it slants a little backward to come at the Groove behind the internal Condyle of the *Os humeri*, through which it runs to the *Ulna*: In its Course along this Bone, it serves the neighbouring Muscles and Teguments; and as it comes near the Wrist, it detaches a Branch obliquely over the *Ulna* to the Back of the Hand, to be lost in the convex Part of several Fingers. The larger Part of the Nerve goes streight forward to the internal Side of the *Os pisiforme* of the Wrist; where it sends off a Branch which sinks under the large Tendons in the Palm, to go cross to the other Side of the Wrist, serving the *musculi lumbricales* and *interossei*, and at last terminating in the short Muscles of the Thumb and Fore-finger. What remains of the ulnar Nerve, after supplying the short Muscles of the Little-finger, divides into three Branches; whereof two are extended along the Sides of the Sheath of the Tendons of the Flexors of the Little-finger, to furnish the concave Side of that Finger; and the third Branch is disposed in the same way upon the Side of the Ring-finger next to the Little-finger.

When

When we lean or press on the internal Condyle of the *Os humeri*, the Numbness and Prickling we frequently feel, point out the Course of this Nerve. I have seen a Weakness and Atrophy in the Parts which I mentioned this Nerve to be sent to, after a Wound in the internal lower Part of the Arm.

7. *RADIALIS* accompanies the humeral Artery to the bending of the Elbow, serving the Flexors of the Cubit in its Way; then passing through the *pronator Radii teres* Muscle, it gives Nerves to the Muscles on the Fore-part of the Fore-arm, and continues its Course near to the *Radius*, bestowing Branches on the circumjacent Muscles. Near the Wrist, it sometimes gives off a Nerve which is distributed to the Back of the Hand, and the convex Part of the Thumb, and several of the Fingers, instead of the Branch of the Muscular. The larger Part of this Nerve, passing behind the annular Ligament of the Wrist, gives Nerves to the short Muscles of the Thumb; and afterwards sends a Branch along each Side of the Sheath of the Tendons of the Flexors of the Thumb, Fore-finger, Mid-finger, and one Branch to the Side of the Ring-finger, next to the Middle, to be lost on the concave Side of those Fingers.

The Manner of the going off of these Nerves of the Fingers, both from the *Ulnar* and *Radial*, is, that a single Branch is sent from the Trunk to the Side of the Thumb and Little-finger farthest from the other Fingers; and all the rest are supplied by a Trunk of a Nerve, which splits into two

some way before it comes as far as the End of the *Metacarpus*, to run along the Sides of different Fingers that are nearest to each other.

It might have been observed, that, in describing the posterior Branches of the *ulnar* and *muscular Nerve*, I did not mention the particular Fingers, to the convex Part of which they are distributed. My Reason for this Omission is, the Uncertainty of their Distribution; for though sometimes these posterior Branches go to the same Fingers, to the concave Part of which the anterior Branches of the *Ulnar* and *Radial* are sent, yet frequently they are distributed otherwise.

The Situation of these brachial Nerves in the *Axilla*, may let us see, how a Weakness and Atrophy may be brought on the Arms by long continued Pressure of Crutches, or such other hard Substances on this Part; and the Course of them from the Neck to the Arm may teach us, how much better Effects, Vesicatories, or stimulating nervous Medicines, would have, when applied to the Skin, covering the transverse Processes of the *Vertebræ* of the Neck, or at the *Axilla*, than when they are put between the Shoulders, or upon the Spinal Processes, in Convulsions or Palsies of the superior Extremities, where a *Stimulus* is required.

The *TWELVE DORSAL* Nerves of each Side, as soon as they escape from between the *Vertebræ*, send a Branch forward to join the Intercostal, by which a Communication is made

made among them all; and they soon likewise give Branches backwards to the Muscles that raise the Trunk of the Body, their principal Trunk being extended outwards to come at the Furrow in the lower Edge of each Rib, in which they run toward the anterior Part of the *Thorax*, between the internal and external intercostal Muscles, giving off Branches in their Course to the Muscles and Teguments of the *Thorax*.

The *FIRST* Dorsal, as was already observed, is particular in this, that it contributes to form the brachial Nerves; and that the two Branches of the Intercostal, which come down to the *Thorax*, form a considerable Ganglion with it.

The *SIX* lower dorsal Nerves give Branches to the Diaphragm and abdominal Muscles.

The *TWELFTH* joins with the first Lumbar, and bestows Nerves on the *Musculus quadratus Lumborum* and *Iliacus internus*.

May not the Communications of all these Nerves be one Reason, why the Parts they serve act so uniformly and conjunctly in Respiration, and conspire together in the convulsive Motions of Coughing, Sneezing, &c.? — The twitching Spasms that happen sometimes in different Parts of the Muscles of the *Abdomen*, by any Irritation on the Branches of the lower dorsal Nerves, are in danger of occasioning a Mistake in Practice, by their Resemblance to the Colick, *Nephritis*, &c. — The Communications of these lower ones with the Intercostals, may serve to explain the violent Effort

fort of the abdominal Muscles in a *Tenismus* and in Child-bearing.

As the *Intercostal* is so much larger in the *Thorax* than any where else, and seems to diminish gradually as it ascends and descends, there is some Cause to suspect that this is the Trunk from which the superior and inferior Parts are sent as Branches.

The *FIVE LUMBAR* Nerves on each Side communicate with the *Intercostal* and with each other, and give Branches backwards to the Loins.

The *FIRST* communicates with the last Dorsal, sends Branches to the abdominal Muscles, to the *Psoas* and *Iliacus*, and to the Teguments and Muscles on the Fore-part of the Thigh; while its principal Branch joins with the other Nerves, to form the crural Nerve.

The *SECOND LUMBAR* Nerve passes through the *Psoas Muscle*, and is distributed nearly in the same Way as the former; as is also the *THIRD*.

Branches of the *second, third, and fourth*, make up one Trunk, which runs along the Fore-part of the *Pelvis*; and passing in the Notch at the Fore-part of the great Hole common to the *Os Pubis* and *Ischium*, is spent on the *Adductor* Muscles, and on the Teguments on the Inside of the Thigh. This Nerve is called the *OBTURATOR* or *POSTERIOR CRURAL NERVE*.

By united Branches from the *first, second, third, and fourth* lumbar Nerves, a Nerve is formed that runs along the *Psoas Muscle*, to
escape

escape with the external Iliac Vessels out of the *Abdomen*, below the tendinous Arcade of the external oblique Muscle. This Nerve, which is named the *ANTERIOR CRURAL*, is distributed principally to the Muscles and Teguments on the Fore-part of the Thigh. A Branch, however, of this Nerve runs down the Inside of the Leg to the upper Part of the Foot, keeping near to the *Vena saphæna*; in opening of which with a Lancet at the Ankle, the Nerve is sometimes hurt, and occasions sharp Pain at the Time of the Operation, and Numbness afterwards.

The Remainder of the fourth Lumbar and the fifth join in composing the largest Nerve of the Body; which is soon to be described.

Whoever attends to the Course of these lumbar Nerves, and of the spermatic Vessels and Nerves upon the *Psoas* Muscle with the oblique Passage of the *Ureter* over that Muscle, will not be surpris'd, that when a Stone is passing in this Canal, or even when it is inflamed, the Trunk of the Body cannot be rais'd erect, without great Pain; or that the Skin of the Thigh becomes more insensible, and the Thigh is drawn forward, and that the Testicle often swells and is drawn convulsively towards the Ring of the abdominal Muscles.

The *SIX PAIR* of the *FALSE VERTEBRÆ* consist each of small posterior Branches sent to the Hips, and of large anterior Branches.

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The *first*, *second*, and *third*, after coming through the three upper Holes in the Fore-part of the *Os sacrum*, join together with the fourth and fifth of the Loins, to form the largest Nerve by much of the Body, which is well known by the Name of *SCIATIC* or *ISCHIATIC* Nerve: This, after sending large Nerves to the different Parts of the *Pelvis*, and to the external Parts of Generation and the *Podex*, as also to the Muscles of the Hips, passes behind the great *Tuber* of the *Os Ischiûm*, and then over the *Quadrigemini* Muscles to run down near to the Bone of the Thigh at its Back-part, giving off Nerves to the neighbouring Muscles and Teguments. Some way above the Ham, where it has the Name of the *Popliteus* Nerve, it sends off a large Branch that passes over the *Fibula*, and sinking in among the Muscles on the anterior external Part of the Leg, runs down to the Foot, to be lost in the upper Part of the larger Toes, supplying the neighbouring Muscles and Teguments every where in its Passage. The larger Branch of the *Sciatic*, after giving Branches to the Muscles and Teguments about the Ham and Knee, and sending a large cutaneous Nerve down the Calf of the Leg, to be lost at last on the Outside of the Foot and upper Part of the lesser Toes, sinks below the *Gemellus* Muscle, and distributes Nerves to the Muscles on the Back of the Leg; among which it continues its Course, till passing behind the internal *Malleolus*, and in the internal Hollow of the *Os calcis*,
it

It divides into the two plantar Nerves: The internal of which is distributed to the Toes in the same Manner as the radial Nerve of the Hand serves the concave Side of the Thumb and Fingers; and the external Plantar is divided and distributed to the Sole of the Foot and Toes, nearly as the ulnar Nerve is in the Palm of the Hand, and in the concave Part of the Fingers.

Several Branches of these Nerves, that serve the *inferior Extremities*, pierce thro' Muscles.

By applying what was said of the Nerves in general to the particular Distribution of the Nerves of the *inferior Extremities*, we may see, how People with fractured Legs, especially where there are Splinters, should be so subject to convulsive Startings of the fractured Member; — why, upon tying the Blood-vessels in an Amputation of the Leg, the Patients should sometimes complain of violent Pain in their Toes; — why such Patients should also be troubled with Startings; — why, for a considerable Time after the Amputation of the diseased Limb, when the Suppuration is well advanced, they should complain of Pain in the Sore which occasioned the Amputation.

The *FOURTH*, which, with the two following, is much smaller than the three superior, soon is lost in the *Vesica urinaria* and *Intestinum rectum*.

The *FIFTH* comes forward between the Extremity of the *Os sacrum* and *Coccygis*,
to

to be distributed principally to the *Levatores Ani*.

The *SIXTH* advances forward below the broad Shoulders of the first Bone of the *Os Coccygis*, and is lost in the *Spinster Ani* and Teguments covering it.

The Branches of the four last cervical Nerves, and of the first Dorsal, which are bestowed on the *superior Extremity*, and the two Crurals, with the Sciatic, which are distributed to the *inferior Extremities*, are much larger proportionally to the Parts they serve, than the Nerves of the Trunk of the Body, and especially of the *Viscera*, are; and for a very good Reason, that in the most common necessary Actions of Life, a sufficient Quantity of Fluid, on which the Influence of Nerves seems to depend, may be supplied to the Muscles there, which are obliged to perform so frequent and violent Contractions.—The Size of the Nerves of the *inferior Extremities* seems larger proportionally than in the *superior Extremities*; the *inferior Extremities* having the Weight of the whole Body to sustain, and that frequently at a great Disadvantage. What the Effect is of the Nerves here being injured, we see daily, when People happen, by sitting wrong, to compress the sciatic Nerve, they are incapable for some time after to support themselves on the affected *Extremity*: And this is still more remarkable in the *Sciatic* or *Hip-gout*, in which the Member is not only weakened, but gradually shrivels and wastes.

OF THE
SYSTOLE and DIASTOLE

OF THE
H E — A R T,

And the reciprocal Actions of its

AURICLES and VENTRICLES.

THAT the Account I am to give of the alternate Motions of the Heart may be rightly understood, it will be necessary to premise the following Propositions, on which it depends.

I. All Muscles are furnished with Blood-vessels and Nerves, and their Action depends on the Influx of Blood, and of the nervous Fluid into their muscular Fibres; therefore, whenever Muscles are deprived of a sufficient Quantity of either one or other of these Liquors, or of both, their Action is weakened or ceases. The Truth of this

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has been fully proved by the Experiments of compressing, tying and cutting the Nerves or Arteries of Muscles.

2. All Muscles are in a constant State of Action, as long as Blood and nervous fluid are freely supplied to them. This seems evident from the continued Contraction of the Sphincters of the Bladder and *Anus*, and of Muscles, whose Antagonists are cut asunder, or become paralytic.

Though in these Propositions I have assumed a Fluid of the Nerves, for the Probability of which, see the Arguments in the foregoing Treatise; yet, to avoid a Dispute, it may be here remarked, that the following Account of the Heart's Motions will equally hold good, by supposing the Nerves to be solid Cords acting by Elasticity, Vibration, &c. if it is only granted, that their Action is necessary to the Contraction of Muscles, and that Compression is capable to hinder that Action; which Experiments plainly shew it is.

3. The Nerves of the Heart pass to it between the two Auricles or two Arteries, and between the Auricles and Arteries.

4. The *Coronary* Arteries, which are the only ones that supply the Heart, rise from the *Aorta* immediately above the middle loose Part of the semilunar Valves, in the same Height of the *Aorta*, as where the Angles of these Valves are fixed.

5. The Edges of the semilunar Valves are duplicated with a muscular Corpuscle in the Middle, and muscular Cords running obliquely

liquely from that Corpuscule to the Insertion of the Valves into the *Aorta*.

The Truth of these three last Propositions is evident from Dissections.

6. Before the Vessels in which the Circulation is performed can act, it is necessary to suppose them full of their Liquors; otherwise the whole vascular System could not be all at once put into Action, and the Motion of the Fluids sent out from the Heart could not be propagated to that in the returning Vessels; consequently the Circulation would be stopped almost as soon as begun.

If then both Auricles and Ventricles attempt, upon the first Communication of Motion, to contract, the Ventricles being stronger, will force their own Contraction, and hinder the Contraction of the Auricles, which must be, in the mean time, much dilated by the Influx of Blood from the Veins, (Prop. 6.); and at this Time the Arteries are also distended by the Blood thrown out of the Ventricles; therefore the Cardiac Nerves lying between them, (Prop. 3.) are compressed, and prevented from exerting their Office. While this happens to the Nerves, the Blood rushing out of the left Ventricle into the *Aorta*, and thrusting the semilunar Valves outwards and upwards, distends the great Artery considerably, whereby the Valves are stretched, and their lunated Edges are brought to be streight and as high as their Angles; consequently these Edges, thus raised and

pressed to the Sides of the *Aorta*, are made to cover the Orifices of the *Arteriæ coronariæ*, which the Corpuscles will assist to do more adequately; and therefore, while they are in this Situation, no Blood can be sent to the Substance of the Heart. If then the Nerves do not exert their Office, and Access is denied to the Blood, this Muscle, the Heart must (by Prop. 1.) become paralytic or unactive.

The Auricles, which were attempting all, this time to contract themselves, will now, when the Resistance to them is removed, throw the Blood they contain into the Ventricles; and the Arteries that were violently distended while the Ventricles pushed the Blood into them, will at this same Time when the Ventricles cease to act, constrict themselves; and the *Valvulæ semilunares* will, by their Elasticity, assisted by the muscular Corpuscles and Cords, be depressed inwards. Since then, by the Constriction of the Auricles and Arteries, the Nerves of the Ventricles are freed from the Compression they suffered while the Auricles and Arteries were distended; and since the Blood in the *Aorta*, pressed strongly by the contracting Sides of this Artery, and resisted by the Liquors which are to be thrown through all its Branches, is also pushed with great Force on the Orifice of the left Ventricle, thrusts back the semilunar Valves which stop its Entry into that Cavity, and impetuously rushes into the coronary Arteries: since then, I say, the Nerves of the Heart are again

gain free from Compression, and the Blood is again sent to the Heart by its Arteries, its muscular Fibres must again contract, (by Prop. 2.). And thus, as long as these Causes continue to act and cease alternately, their Effects must be exerted in the same Manner; that is, as long as an Animal lives, the Heart must have an alternate State of Contraction, called its *Systole*, and of Relaxation, or *Diastole*; and the Auricles and Arteries must be dilated, while the Ventricles are contracting; and the Ventricles must be dilated, while the Auricles and Arteries are constricted; or their Actions must always be reciprocal.

T H E

THE DESCRIPTION

OF THE HUMAN

LACTEAL SAC and DUCT.

THE *Receptaculum Chyli* of Pecquet, or *Saccus Lacteus* of Van Horne, is a membranous somewhat pyriform Bag, two thirds of an Inch long, one third of an inch over in its largest Part when collapsed; situated on the first *Vertebra* of the Loins to the right of the *Aorta*, a little higher than the right emulgent Artery, behind the right inferior Muscle of the Diaphragm: It is formed by the Union of three Tubes, one from under the *Aorta*, the second from the Interstice of the *Aorta* and *Cava*, the third from under the Emulgents of the right Side. The *Lacteal Sac*, becoming gradually smaller towards its upper Part, is contracted into a slender membranous Pipe, of about a Line Diameter, which is generally named the *THORACIC DUCT*. This passes betwixt the muscular *Appendices* or inferior Muscles of the Diaphragm, on the right of, and somewhat behind the *Aorta*: then, being

ing lodged in the cellular Substance behind the *Pleura*, it mounts between the *Aorta* and the *Vena Azygos* as far as the fifth *Vertebra* of the *Thorax*, where it is hid by the *Azygos*, as this Vein rises forwards to join the descending or superior *Cava*; after which the Duct passes obliquely over to the left Side behind the *OEsofagus*, *Aorta descendens*, and great Curvature of the *Aorta*, until it reaches the left carotid Artery; behind which, and on the left Side of the *OEsofagus*, it runs to the Interstice of the first and second *Vertebra* of the *Thorax*, where it begins to separate from the carotid, stretching farther towards the left internal Jugular Vein by a circular Turn, whose convex Part is uppermost. At the Top of this Arch it splits into two for a Line and an half; the superior Branch receiving into it a large lymphatic Vessel from the cervical Glands. This Lymphatic appears, by blowing Air, and injecting Liquors into it, to have no Valves. When the two Branches are again united, the Duct continues its Course towards the internal Jugular Vein; behind which it descends, and, immediately at the left Side of the Insertion of this Vein, enters the superior posterior Part of the left subclavian Vein, whose internal Membrane duplicated, forms a semilunar Valve that is convex externally, and covers two thirds of the Orifice of the Duct; immediately below this Orifice, a cervical Vein from the *Musculi scaleni* enters the subclavian.

The

The Coats of the *Sac* and *Duët* are thin transparent Membranes; from the Inside of which, in the *Duët*, small semilunar Valves are produced, most commonly in Pairs; which are so situated, as to allow the Passage of Liquors upwards, but oppose their Return in an opposite Course. The Number of these is generally ten or twelve.

This is the most simple and common Course, Situation, and Structure of the *Receptaculum chyli* and *thoracic Duët*; but having had Occasion to observe a Variety in these Parts, of different Subjects, I shall set down the most remarkable of them.

The *Sac* is sometimes situated lower down than in the former Description; is not always of the same Dimensions; is not composed of the same Number of *Duëts*; and frequently appears divided into several small Cells, instead of being one simple Cavity.

The Diameter of the *Duët* is various in most Bodies, and is seldom uniform in the same Subject; but frequently sudden Enlargements or *Sacculi* of it are observable. — The Divisions which Authors mention of this *Duët* are very uncertain. I have seen it divided into two, whereof one Branch climbed over the Fore-part of the *Aorta* at the eighth *Vertebra* of the *Thorax*, and at the fifth slipped behind that Artery, to join the other Branch which continued in the ordinary Course. — The precise *Vertebra*, where, it begins to turn to the left Side, is also uncertain. — Frequently it does not split at its superior Arch; in which Case a large *Sac* is found

found near its Aperture into the subclavian Vein.—Generally it has but one Orifice ; though I have seen two in one Body, and three in another : Nay, sometimes it divides into two, under the Curvature of the great Artery ; one goes to the right, another to the left subclavian Vein ; and I have found this Duct discharging itself entirely into the right Subclavian. — The lymphatic Vessel which enters its superior Arch, is often sent from the *thyroid* Gland.

Whether is not the Situation of the *Receptaculum chyli* so much nearer the muscular *Appendices* of the Diaphragm in Men than in Brutes, designed to supply the disadvantageous Course the Chyle must otherwise have in our erect Posture ?

Does not the Descent of the End of the Duct to the subclavian Vein, and the opening of the lymphatic into the Top of the Arch, contribute to the ready Admission of the Chyle into that Vein ?

F I N I S.



